The Effectiveness of Physics Learning Online Based on Guided Discovery Models to Improve Critical Thinking Skill

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ABSTRACT

Critical thinking skill is one of the abilities that must be possessed by students in the 21st century. Online learning combined with guided discovery models, is intended to be able to improve students' critical thinking skills at the high school level. This study aims to look at the effectiveness of online learning based on guided discovery models on the material of momentum and impulses to improve the critical thinking skils of high school students in class X. The research method uses quasi experimentation. The results of the study for experimental class 1 with the help of the LMS Schoology effect size score of 1.971758665 in the high category and experimental class 2 with the help of WhatsApp Application Group effect size score of 2.12844972 in the high category.

Keywords: online learning, guided discovery, critical thinking, momentum and impulse.

1. INTRODUCTION

Answering the challenges of the development of the 21st Century which is increasingly rapid, the need for learning that is designed to be able to practice the ability of the 21st Century. The ability to think critically is one of the six elements of 21st Century abilities that must be possessed by students [1]. The learning process in the 21st-century competence in the use of the internet requires students to be directly involved, not just limited to searching for information but students can carry out learning online [2].

The expansion of technology in the current era called the 4.0 Revolution-era provides many changes in every aspect of life including in improving the quality of education [3]. Technology as a facility for students and teachers to have classes without face-to-face meetings but with online classes using all kinds of products from technology [4], [5]. Nowadays, the use of computers and the internet is done easily and quickly to convey learning material information via email, web sites, and online learning systems [3], [4].

Data from the Ministry of Education and Culture in 2018, the total number of middle and high school students is 14.9 million students. 7 million middle and high school students in Indonesia have studied online

with various applications [6], [7]. The low level of adjustment of online learning and the importance of interaction between teacher-students and between students in the classroom have suggested that online learning alone may not be the most effective strategy for teaching and learning [8]. But with the presence of the teacher can be as a facilitator to set the learning agenda and illustrate how online activities can work effectively [9], [10].

An online learning system is a new system in education that utilizes information technology to support the learning process [11], [12]. The design of online learning models is distinguished by several types, one of which is a class learning model which is divided into two, namely using class teaching records and using a learning management system (LMS) [13]. The design model uses special software called a Learning Management System or LMS. This LMS is designed to replicate/imitate virtual/virtual classrooms where facilities ('spaces') are available to upload learning materials, discussions, assignments, assignment assessments, etc. needed for a learning activity [14].

The spread of pandemic diseases in the world including in Indonesia caused by SARS-Cov2 known as Coronavirus disease (COVID-19) which is vulnerable to children so it does not allow learning to be done face-to-

face to prevent transmission of the COVID-19 virus [15], [16]. If online learning is well designed, delivered, and packaged, students can learn effectively and get significant results compared to unplanned and well-structured online learning. [17].

Guided discovery model, namely learning begins with the instructions of the teacher with the syntax starting from the core questions, the teacher asks various questions that track intending to direct students to the expected conclusion, then students conduct experiments to prove the opinions expressed [18]. Learning with the discovery model requires teachers to be more creative and students more active in creating an atmosphere of discovery learning independently [19].

Momentum and impulse material is compulsory material taught according to the 2013 curriculum at the level X of the Mathematics and Natural Sciences High School. However, the results of HOTS (high order thinking skills) student learning is still very low [20]. Physics learning by combining face-to-face learning with online learning (Blended learning) can improve students' critical thinking skills [21]. Physics learning in sub-material types of collisions assisted by LMS Edmodo can improve students' critical thinking skills [22].

2. RESEARCH METHOD

This study uses a quasi-experimental method with Pretest-Posttest Control Group Design can be seen in table 1. The sample consisted of 2 class X Mathematics and Natural Sciences State High School 1 Ngemplak, experimental class 1 amounted to 35 students and experiment class 2 amounted to 35 students. The experimental class 1 was treated using LMS Schoology and the experimental class 2 was treated 2 using WhatApp Group Application. Assessment of critical thinking skills is done twice, namely the pretest and posttest using essay questions. Critical thinking ability data in the form of pretest and posttest graph of each indicator of critical thinking ability, results of Multivariate Normality data, Homogeneity Test results, Correlation Analysis results, and Effectiveness Scale Tests [23].

Table 1. Experimental design

Class	Pretest	Treatment	Posttest
Experiment 1	O1	X	O2
Experiment 2	O1	Y	O2

Description; X: LMS Schoology-assisted online learning, Y: WhatsApp Group Application assisted online learning.
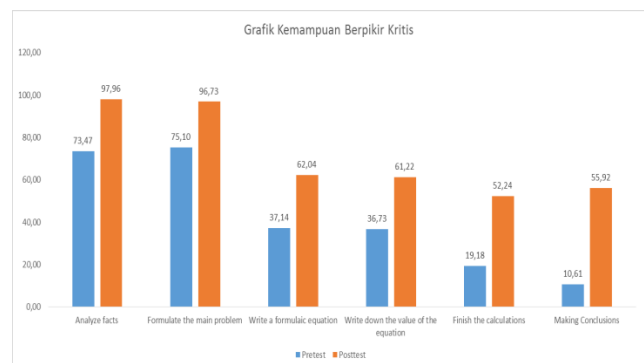
3. RESULT

After 3 weeks of giving treatment, students carry out a posttest to see the effect of online learning based on guided discovery models on students' critical thinking skills. Posttest was carried out in the experimental class 1 and experiment 2, then the posttest results obtained

were combined with the pretest results in the graph. The results of the pretest and posttest of the experimental class 1 can be seen in graph 1 and the results of the pretest and posttest of the experimental class 2 can be seen in graph 2.
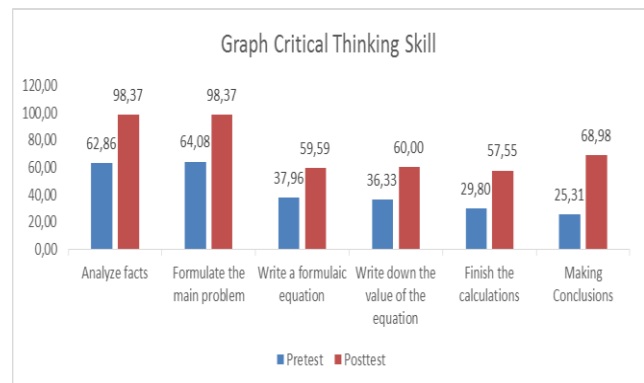
Graph 1. The results of the comparison of the pretest-posttest value of critical thinking skills of the experimental class 1

Based on graph 1 it can be seen that there is an increase in the ability to think critically based on existing indicators.

Graph 2. The results of the comparison of the pretest-posttest value of critical thinking skills of the experimental class 2

Based on graph 2 it can be seen that there is an increase in the ability to think critically based on existing indicators. However, if you look at the comparison with the results of experimental class 1, it appears that the posttest value achieved is almost the same.

Testing the effectiveness of online learning, then first tested the requirements of multivariate data normality and homogeneity of data to adjust the further tests that must be done. The results of the effectiveness test are as follows:

Multivariate normality data obtained from the *chi-square* value, with the results can be seen in table 2.

Table 2. Multivariate normality test

		Chiq
Pretest	Sig. (2-tailed)	0,000
Posttest	Sig. (2-tailed)	0,000

Based on table 2, it is known that the value of sig 0.00, which is sig <0.05. Based on this, then H_0 is accepted, multivariate normality data distribution.

Homogeneity data is taken from the students' posttest values with the results can be seen in the *Levene's Test of Equality of Error Variances table.* Homogeneity can be seen in table 3.

Table 3. Homogeneity Data

Measuring Variable	Sig.
Critical Thinking	0,276

Based on the data obtained, it is known that the significance value of critical thinking skills is 0.276> 0.05 so that the data is homogeneous. Based on these values the normality and homogeneity of data requirements are met, then test the effectiveness scale by calculating the *effect size* values as follows:

Table 4. *Paired samples statistics* experimental class 1

Critical Thinking		Mean	N	*Effect Size*
Pair 1	Pretest value of critical thinking	43,17	35	1,971758665
	Posttest value of critical thinking	73,89	35	

Based on the data in table 4, it is known that the effect size value is in a large category, which means that treatment gives a large contribution to the effectiveness of critical thinking skills.

Table 5. *Paired samples statistics* experimental class 2

Critical Thinking		Mean	N	*Effect Size*
Pair 1	Pretest value of critical thinking	42,14	35	2,12844972
	Posttest value of critical thinking	71,37	35	

Based on the data in table 5, it is known that the *effect size* value is in a large category, which means that treatment gives a large contribution to the effectiveness of critical thinking skills.

4. DISCUSSION

The application of online learning based on guided discovery models on the material of momentum and impulses can improve the critical thinking skills of students in grade X MIPA high school. So the experimental research that has been done can find out the effectiveness of online learning based on guided discovery models to train students' critical thinking skills. Based on table 4, it is known that the *effect size* value for online learning assisted by *LMS Schoology* is 1.971758665. While. Table 5 shows the value of the *effect size* for online learning aided by the *WhatsApp group application* of 2.12844972. *Effect size* values obtained in different treatments are included in the large category with a range of *effect size values* $\geq$ 0.8 including large criteria [24].

The results obtained in this research are not optimal because there are several limitations and shortcomings. The need for students to habituate and adapt to online learning based on guided discovery models assisted by *LMS Schoology* and *WhatsApp group application* can be one of the causes of not achieving maximum learning outcomes. Then the need for further research that requires at least 6 months to see an increase in the ability of students and get good results [25].

Each class experiences an increase in critical thinking skills on all indicators. However, there are significant differences in the pretest scores in the experimental class 2 using WhatsApp media application scapegoat compared to the experimental class 1 using LMS Schoology, where the pretest scores in the experimental class 2 have higher scores on several indicators. After being given teaching materials in the form of LKPD and handouts based on guided discovery models and the same treatment that is by online learning both classes have increased in the assessment of critical thinking skills. The application of guided discovery models in the learning process can improve students' critical thinking skills [26]. The use of guided discovery-based handouts in learning at the high school level can improve students' critical thinking skills [27]. Using LKPD based on guided discovery models on complex and complex material can improve participants' learning outcomes [28].

Motivation is action from within students that is needed to foster a sense of learning so that learning motivation is always awake during learning [29]. it is necessary to adjust the use of instructional media to the learning styles and needs of students [30]. There are different motivations and learning styles of students during the learning process causing learning outcomes that are not optimal.

5. CONCLUSION

Based on the results of the study, it can be concluded that online physics learning based on guided discovery models on momentum and impulse material is effective for training and improving critical thinking skills of high school level X class students. The use of online physics learning devices based on guided discovery models can be used as consistent and sustainable as a learning solution when certain conditions require teachers and students to do learning without face to face.

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