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The Effect of Learning Simulation Media on the Students' Critical Thinking Skills in Vocational School during Online Learning in the Covid-19 Pandemic

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Abstract – Critical thinking is one of the most important and necessary skills in learning physics. This study aims to determine the effect of simulation learning media on critical thinking skills during online learning. This research is a pre-experimental study with one group pre-test post-test design. This research was conducted in the even semester of the 2020/2021 academic year at the State Vocational High School 1 Grati. The sample was selected using a simple random sampling method and obtained class X TPL 1 with 30 students. The results of the pre-test and post-test data analysis showed that there was an increase in students' critical thinking skills after applying simulation media. the average result of the n-gain of students' critical thinking skills after learning using simulation media is 60.51 which is in the quite effective category. A paired t-test results show the value of sig (2-tailed) is $0.00 < \text{sig } \alpha 0.05$. Based on the results, it can be concluded that the implementation of learning simulation media can improve students' critical thinking during online learning on temperature and heat material.

Keywords: critical thinking; learning media; online learning; simulation

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I. INTRODUCTION

The process of critical thinking skills is very important in learning physics. Fithriyah et al. (2016) said that what must be considered in giving birth to individuals who meet global demands is to create a generation that has the ability to think critically. Someone who has the ability to think critically will not easily believe before knowing the facts around them through valid and reliable evidence. According to

Ennis (2018), critical thinking is thinking with reason and reflection by prioritizing making decisions about what to do or believe. Critical thinking is thinking rationally and clearly about what to do or believe, including the ability to engage in independent or reflective thinking Lau and Chan (2018). Kowiyah (2012) also explains that critical thinking is a model of thinking about any problem when the thinker improves the quality of his thinking

skillfully with the structures inherent in thinking. Critical thinking skills are abilities possessed by everyone that can be trained, measured, and developed (Lambertus, 2009).

Physics lessons are considered difficult for students so that most students have low interest in learning physics. In line with this statement, Tania and Jumadi (2021) stated that most students had difficulty in understanding formulas, and solving problems in physics learning. Saputra and Kuswanto (2019) also explained that students' thinking skills have not been developed optimally. Previous studies (Azmy et al., 2020; Trisdiono et al., 2019) explained the demands of the 21st century which require students to have critical thinking skills. Therefore, the teaching and learning process of physics must focus on the assumption that physics is a subject that requires higher-order thinking skills, such as critical thinking..

Syawaludin et al. (2019) argued that the limitations of media cannot support interactive learning and are not oriented towards empowering critical thinking skills. A study conducted by Puspita et al. (2017) showed that students' critical thinking skills in static fluid materials are still low even though critical thinking is very important in the 2013 curriculum. The fact shows that most teachers usually only use general learning media such as textbooks, learning videos, or powerpoints in classroom learning (Fauziah & Kuswanto, 2021). In addition, many teachers have not adapted to the rapid development of

technology, even though currently teachers are required to use technology in the learning process (Sholihah et al., 2020)

Several efforts have been made in improving students' critical thinking skill. According to Suparya (2020), the application of problem-based learning model assisted by Edmodo media can improve students' critical thinking skills from 69.50% in the first cycle to 84.40% in the second cycle. Other researchers, Oktaviany et al. (2020), Zikri et al. (2020), and Erfan and Ratu (2018), stated that there is an increase in students' critical thinking skills through the application of scientific learning. Problem-based learning models can also improve students' critical thinking skills in elementary schools (Afrillia et al., 2021; Amalia et al., 2020). The application of the learning model contextual teaching and learning assisted by the knowledge rubber throwing media is also an alternative in improving students' critical thinking skills (Setyawati et al., 2020).

Based on the description above, it can be concluded that the improvement of critical thinking can be done by using learning media. A research conducted by Setiyoadji et al., (2020) using the development of e-book media to assist students in analyzing the magnitude of the material in a straight motion. A development research was also carried out by Tazkiyah et al. (2020) using an android-based electronic module. Both studies concluded that the use of media can help students' understand difficult concepts. Other research also states

that the use of learning comics media can support students in understanding the physics concepts (Rosdiana & Kholiq, 2021). Recently, virtual laboratory simulation media has become an alternative in understanding physics concepts (Bancong et al., 2021). A virtual laboratory is a simulation of a mathematical model that is implemented on a computer (Reilly, 2008). The benefit of using a virtual laboratory simulation is that it can provide a more effective learning experience and can also facilitate deeper learning in the model-based knowledge domain.

Therefore, this study aims to improve students' critical thinking skills through the implementation of simulation media during online learning in the covid-19 pandemic. The research question is whether there is an increase in students' critical thinking skills before and after the implementation of simulation learning media during online learning in the covid-19 pandemic?

II. METHODS

This research is a pre-experimental study with one group pre-test post-test design. The design of this research can be seen in Figure 1 as follows:

Pre-test	Treatment	Post-test
O ₁	X	O ₂

Figure 1. One group pre-test post-test design

This research was conducted in the even semester of the 2020/2021 academic year at

the Grati State Vocational High School, using one class that was treated with learning using simulation media. The sample was selected using a simple random sampling method and obtained class X TPL 1 with 30 students.

In this study, the research subjects will first be given a pre-test to determine the extent of the students' initial abilities before being given treatment in the form of learning simulation media. After being given a pre-test, students were then given treatment, namely learning using simulation media on temperature and heat material. Furthermore, all students will be given a final test (post-test) to determine the effect of learning with simulation media on students' critical thinking skills. The pretest and posttest used multiple-choice questions with the number of each question being 10 questions. The research design for this activity is shown in Table 1 as follows:

Table 1. Research activity design

Pre-test	Treatment	Post-test
Measuring students' knowledge regarding students' initial critical thinking skills by answering 10 questions that have been provided.	Teaching activities are carried out online during class hours, where students are given a learning simulation media	Measures students' knowledge regarding students' critical thinking skills after conducting simulations by answering 10 questions that have been provided.

The scores were pre-test and post-test calculated based on the assessment rubric that had been made, while the improvement

achieved by students was analyzed using a normalized n-gain score (Hake, 2002). Mathematically, the equation can be written as follows:

$$g = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$$

The classification of the increase which is indicated by the magnitude (g) is shown in Table 2 as follows:

N-Gain score	Category
< 40	Ineffective
40 – 55	Less effective
50 - 75	Effective enough
> 70	Effective

Validation must be done in every study to obtain input and positive feedback from the media development carried out. Validators are people who are experts in validation activities, which in this study used 2 types of validation, content validation and construct validation. Content validation consists of material validation, questions, and simulations. The validators of the material and questions are teachers who already have professional certificates in the field of education that are competent from learning physics. While the validators of the simulation media are teachers who are competent in the field of Physics and have expertise in making learning media. The number of validators in this study were 5 validators who had experience and competence in their field. The following criteria for media validity are referred to in Table 3 (Arikunto, 2010).

Table 1. Media validity criteria

Average score	Category
3,26 – 4,00	Very valid
2,51 – 3,25	Quite valid
1,76 – 2,50	Not valid
1,00 – 1,75	Invalid

For data analysis in this study, paired t-test was used. This test is used to determine the difference in the mean of two paired samples (Gunawan, 2013). This test is used to answer the hypothesis in the study that there is an effect of using simulation media on students' critical thinking skills. Decision making is done using a significance level (α) of 0.05. If the value of sig < 0.05 then the hypothesis is accepted. with the help of SPSS, also to answer the hypothesis o

III. RESULTS AND DISCUSSION

The results of the content validation of the validator show that all criteria are valid. The first aspect is the material aspect, which includes the truth of physical theory, obtaining an average value of 3.92 in the valid category. The second aspect is the question aspect, which includes the truth of the questions that get an average value of 4 in the valid category. Then the third aspect is the simulation which gets an average value of 3.94 and is in the valid category. The results of content validation can be seen in table 4 as follows.

Table 4. Content validation results

Aspect	Score	Category
Material	3.91	Valid
Questions	4	Valid
Simulation	3.94	Valid

In construct validation, there are 5 aspects of the assessment, display/layout, language, image and video, usability, and android. In the developed electronic book, there are still revisions based on comments from the validator. The results of the recapitulation of content validation provided by the validator are shown in Table 5.

Table 5. Construct validation results

Aspect	Score	Category
Display	3.67	Valid
Language	3,91	Valid
Image and video	3,83	Valid
Usability	4	Valid
Android	4	Valid

This study aims to determine the effect of the application of learning simulation media on the improvement of students' critical thinking on temperature and heat material in

online learning during a pandemic. The physics learning simulation media on temperature and heat materials developed can be seen in Figure 2.



Figure 2. An example of temperature and heat learning simulation media developed

By using a multiple-choice test of 10 items, the results of the pre-test and post-test scores were obtained. The average value of the pre-test was 27.33, while the average value of the post-test was 70.33. The data shows that there are differences in the pre-test and post-test scores after the application of simulation media in class X TPL, Grati State Vocational High School. Figure 3 below is the result of the students' critical thinking skills in the pre-test and post-test.

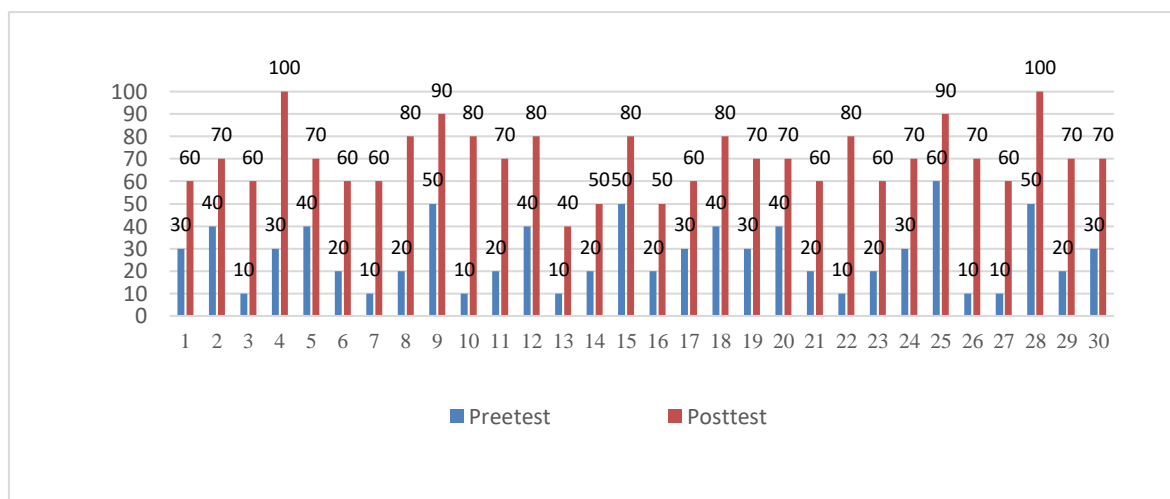


Figure 3. The score of pre-test and post-test of students' critical thinking skills

The results of the pre-test and post-test data analysis showed that there was an increase in students' critical thinking skills after applying simulation media. The increase is indicated by the average post-test result being greater than the pre-test result. Based on table 6, the average achievement of students' critical thinking skills is 26.67 for the pre-test and 70.33 for the post-test. This indicates that there is an increase in students' critical thinking skills after and before using simulation media. The descriptive statistics of the pre-test and post-test are presented in figure 4 below.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test	27.33	30	14.37	2.62
	Post-test	70.33	30	14.02	2.56

Figure 4. Descriptive statistics of students' critical thinking skills

Table 6 shows the results of the n-gain test. As can be seen, the average result of the n-gain of students' critical thinking skills after learning using simulation media is 60.51

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - post-test	-43.00000	12.90549	2.35621	-47.81899	-38.18101	-18.250	29	.000

Figure 5. Paired sample test results.

The results of this study are in line with the studies conducted by Damayanti et al. (2016) and Muchlis et al. (2018) which shows that the use of interactive learning simulation

which is in the quite effective category. From the results of the n-gain test, it shows that there has been an increase in students' critical thinking skills before and after the implementation of the simulation media even though it is not optimal.

Table 6. Average N-gain

Acquisition score	N-gain score
Lowest gain	33.33
Top gain	100.00
Average N-gain	60.51
Category average N-gain	Effective enough

To answer the research question whether there is a significant effect of using simulation media on critical thinking skills, a paired t-test was conducted. The results can be seen in figure 5. As can be seen, the value of sig (2-tailed) is $0.00 < \text{sig } \alpha 0.05$. This gives the conclusion that there is a significant difference between students' critical thinking skills on the pretest and posttest.

media can improve students' critical thinking skills. Ekawati et al. (2015) also said that the use of physics learning simulation media can increase students' learning motivation which

has an impact on increasing learning outcomes. Increasing students' critical thinking skills by using simulation media in the learning process is related to the characteristics of the learning simulation media itself. Learning simulation media is included in the media resulting from a combination of print and computer technology that combines static and dynamic text, images or visuals, and audio, all of which are controlled by a computer (Arsyad, 2013). Learning simulation media is considered capable of stimulating to do exercises, simulations, and so on. Simulations can add to the impression of realism, can stimulate exercises and laboratory activities. This is influenced by the results of image manipulation being realistic so that it attracts the attention of users to learn (Manfaat & Anasha, 2013).

The data from the pretest and posttest showed that there were 11 students who experienced a significant increase, while 19 students experienced a less significant increase. This is due to several factors, such as motivation, the influence of the student's environment, and the student's physical condition. Motivation is an impulse in students to do something in order to achieve goals (Emda, 2018). Motivation has an important influence on the learning process. Students who have preparation will get satisfactory results compared to students who do not have preparation before learning begins. A

supportive environment can also have an influence on student learning outcomes. A conducive environment can help students in the process of understanding the material. In addition to motivation and environment, students' physical condition also plays an important role in learning. Students whose physical condition is fit will be much more focused on paying attention to learning, compared to students whose physical condition is not good.

Learning that uses simulation media tends to attract students' attention more than conventional media (Andriani et al., 2021). Therefore, the simulation media will attract students' curiosity in the learning process. The simulation media developed not only includes material and questions but also includes virtual laboratory simulations that support students' understanding to support students' critical thinking skills.

In simulation media, students can carry out experiments that can be carried out in everyday life. In this learning simulation media students can also know the phenomena and concepts in physics learning about temperature and heat. In general, learning simulation media are very helpful in the practicum-based learning process because with learning simulation media students can learn easily in understanding the material that has been studied (Dewi et al., 2016; Andriani et al., 2021).

IV. CONCLUSION AND SUGGESTION

Based on the results of data analysis, it can be concluded that the implementation of learning simulation media can improve students' critical thinking during online learning on temperature and heat material. The results of data analysis showed that there was an increase in students' critical thinking skills before and after being given simulation learning media. This study has limitations because it only uses one class. Therefore, it is suggested for further research to use a larger and more varied sample class. Further research is also expected to be carried out optimally.

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