

EXAMINING STUDENT RESPONSES OF PhET SIMULATIONS AFTER VIRTUAL LABORATORY PRACTICES

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Abstract: This study aims to describe students' responses to implementing PhET Simulations after joining a virtual laboratory practice. This study employed a survey method. The samples of this study included 80 students in eighth grade, and the data collection was conducted using the questionnaire of students' responses to the use of PhET Simulation. The data of students' responses were displayed in percentages and grouped into five categories: very good, good, satisfying, sufficient, and insufficient. The study results showed that students' interest in PhET Simulations was categorized as good. Group learning feasibility using PhET Simulations was categorized as satisfying, the novelty of PhET Simulations for students was categorized as good, the effectiveness of PhET Simulations was categorized as good, and new information gained from PhET Simulations was categorized as good. The average of students' responses was categorized as good. The results revealed that students respond well to the implementation of PhET Simulations in virtual laboratory practice activities, which should be implemented in the science learning activity during Covid-19 pandemics.

Keywords: *Distance Learning, PhET Simulations, Virtual Laboratory Practice, Student Response.*

INTRODUCTION

The Covid-19 pandemic is currently engulfing the entire world, including Indonesia. It affects the teaching and learning process. According to the circular of the Minister of Education and Culture No. 4/2020 regarding the implementation of education in the Covid-19 emergency, the period can be done by distance learning which is focused on academic achievement, and learning literacy, numeracy, and character education [1]. Online learning is completely changing the world of education, including both modes of teaching and students [2]. Online learning results in low student motivation [3]. Many teachers and students agree that the greatest difficulty during online learning is staying motivated [4]. It is important to increase student engagement during online learning to improve students' knowledge and skills [5].

Science learning cannot be separated from practical activities. During the Covid-19 pandemic, practicum activities could not be carried out due to online learning [6]. Before the Covid-19 pandemic, students carried out practicums in school laboratories. The purpose of carrying out practicum in the laboratory is so that students can solve problems related to the cognitive, affective, and psychomotor domains or conduct experiments using experimental methods so that scientific attitudes can be formed in students [7]. Practical activities in the laboratory involve the use of equipment, instruments, and materials provided by the school to obtain experimental data, which is then analyzed to produce conclusions. The distance learning policy prevents students from attending school laboratories. Practical activities that students

can carry out at home are simple practicum activities. However, this cannot cover more complex materials [8].

Practicum using PhET Simulations is a solution that can be used to increase student engagement. However, based on the results of interviews with science teachers at SMPN 40 Surabaya, it was stated that before and during the Covid-19 pandemic, students had never had experience carrying out virtual laboratory practicums using PhET Simulations. It makes virtual laboratory practicums using PhET Simulations, a new thing for students. The effectiveness of using a virtual laboratory depends on the desire of students, or students must be motivated enough to interact with the virtual laboratory system. Students who do not have enough motivation will have a negative experience and will even give up using the system [9]. The most severe consequences for students will leave their learning path. So it is necessary to analyze student responses to using PhET Simulations during virtual laboratory practicums so that future implementation can be maximized in a complete and effective manner. Student responses to the use of PhET Simulations need to be researched to be used as input in the future. If it produces a positive response, the PhET Simulations can be considered for use in the future. Based on these problems, the purpose of this study was to describe student responses after carrying out a virtual laboratory practicum using PhET Simulations.

RESEARCH METHODS

This type of research is survey research to obtain an overview of student responses to using

PhET Simulations for virtual laboratory practicum. The survey was conducted by providing student response questionnaires after students participated in virtual laboratory practicum activities using PhET Simulations. The population and sample of this study were students of junior high school SMP Negeri 40 Surabaya Indonesia. A total of 80 class VIII students of SMPN 40 Surabaya took part in a virtual laboratory practicum using PhET Simulations for basic force and motion material after receiving training to see that these students were proficient in operating PhET Simulations.

The instrument used is a student response questionnaire and a pretest-posttest question. The

question consists of 14 questions about force and motion material. The answer to the student's response questionnaire uses a Likert with 4 alternative answers starting from a score of 1 stating strongly disagree, score 2 stating disagree, score 3 stating agree, and score 4 stating strongly agree [10]. Questionnaires are presented in the form of Google Forms which are distributed online through WhatsApp groups. The student response questionnaire contains 15 statements based on 5 indicators of student response to PhET Simulations, shown in Table 1.

Table 1. Indicators of Students Response Questionnaire

Aspects	Number of the Statement
Students' interest in PhET Simulations	1,2,3
Group learning feasibility using PhET Simulations	4,5,6
The Novelty of PhET Simulations for Students	7,8,9
The effectiveness of PhET Simulations	10,11,12
New information gained from PhET Simulations	13,14,15

The validity test on the response questionnaire using SPSS produces $r_{count} > r_{table}$ with a significance of 0.05 is said to be valid. Then, the reliability test of the response questionnaire was 0.332. The value of > 0.2 so that it can be said that the student response questionnaire to the PhET Simulations is reliable. The data collection technique used is a questionnaire technique. Student response questionnaires to PhET Simulations after participating in the virtual laboratory practicum were distributed via WhatsApp Messenger link to Google.

Questions for evaluating students' knowledge is the data from the student's responses to the virtual laboratory practicum using PhET Simulations were then analyzed quantitatively and descriptively. The questionnaire will be calculated based on a Likert in the form of a percentage. The percentage of results is categorized based on student response criteria in Table 2[11].

Tabel 2. Students Response (R) Criteria

Percentage	Category
$86\% \leq R \leq 100\%$	Very Good
$70\% \leq R \leq 85\%$	Good
$56\% \leq R \leq 70\%$	Enough
$41\% \leq R \leq 55\%$	Less
$R \leq 40\%$	Very Poor

Students' scores were analyzed using N-gain to determine the enhancement of student learning outcomes. The result is analyzed with N-gain (g) criteria [12] below:

Table 3. N-gain criteria

N-gain	Criteria
$(g) \geq 0.7$	High
$0.3 < (g) < 0.7$	Medium
$(g) < 0.3$	Low

Data were analyzed with paired sample t-test. Paired sample t-test is significant if (2-tailed) < 0.05 , and it showed that there is meaningful change. If the significance (2-tailed) > 0.05 , there is no meaningful change. Normality test is used Kolmogorov-Smirnov test.

RESULTS AND DISCUSSION

Students' responses to PhET Simulations after attending a virtual laboratory practicum are shown in Table 3.

Table 3 shows that students' responses with the largest percentage were students who felt they got new information from PhET Simulations, which was 81% (Mean = 3,250, Median = 3, Mode = 3, SD = 0,585) with good category. Then, regarding the effectiveness of PhET Simulations used for practicum on force material (M = 3.125, Median = 3, Mode = 3, SD = 0.736) and motion and the statement that the novelty of PhET Simulations for students (M = 3.137, Median = 3, Mode = 3, SD = 0.896) has the same percentage, which is 78% with good category. Statements about student interest in PhET Simulations had a percentage of 76% (M = 3.035, Median = 3, Mode = 3, SD = 0.818) with a good category, and the lowest percentage was in the ease of group learning using PhET Simulations with a percentage of 69%

(M = 2.775, Median = 3, Mode = 3, SD = 0.842) with sufficient category.

The result of the normality test of the result of the pretest is 0.200 and 0.070 for the posttest. It

showed that the data were distributed normally. The result of the paired sample t-test is shown in table 4.

Table 4 Percentage of Students' Responses

Aspects	Percentage	Category
Students' interest in PhET Simulations	76%	Good
Group learning feasibility using PhET Simulations	69%	Enough
The Novelty of PhET Simulations for Students	78%	Good
The effectiveness of PhET Simulations	78%	Good
New information gained from PhET Simulations	81%	Good

Table 4 paired sample t-test result and N-gain (g)

	n	M	SD	t	p	N-gain	Category
Pretest	80	47.38	22.351	-15.563	.000	0.6	Medium
Posttest	80	78.51	10.489				

Based on the data, the significance score (2-tailed) is 0.000 ($\text{sig} < \alpha$), and it can be concluded that there is a significant change in the pretest score and posttest score. The N-gain score is 0.6 in the medium category.

Based on data from student responses to PhET Simulations after participating in virtual laboratory practicum, as many as 81% of students stated that PhET Simulations provided new information regarding force and motion material. This response is in a good category. In the basic force and motion practicum at PhET Simulations, students carry out a practicum on the amount of force in a form such as tug of war. When carrying out the practicum, students get new information about tug-of-war activities that they already know. Students stated that PhET Simulations were an effective medium for studying force and motion material because, during practicum activities, PhET Simulations provided a practical form with implementation in daily activities and activities that were familiar to students. Students can connect previously known concepts, in this case, daily activities that apply the concepts of force and motion, with things that have just been learned in class to produce meaningful knowledge [13]. Learning that uses actual and factual problems will be able to increase understanding of the material [14].

As many as 78% of students stated that PhET Simulations were new and an effective medium for studying force and motion material in the good category. It relates to previous interviews with science subject teachers who stated that students had never carried out practicum using PhET Simulations during online or offline learning. Students learn the concepts of force and motion with hands-on practice using PhET Simulations. Learning through practical activities that provide direct experience to students can provide more

meaningful knowledge (meaningful learning). The knowledge obtained by students will last longer in students' memories [15]. Students learn these concepts through practicums presented by PhET Simulations in the form of activities that are already known to students so that students can gain conceptual knowledge about force and motion material through familiar activities so that students are more effective in studying the material. Students are given the freedom to find things by themselves so students will better understand the concept of the material [16]. It is also following constructivism learning theory; namely, knowledge is built by integrating learning activities with previous student experiences [17].

The use of PhET Simulations for virtual laboratory practicum also makes students feel interested in the 76% response in the good category because, in PhET Simulations, students can observe the material presented in an attractive form, with icons that students can operate. PhET Simulations is also an interactive medium that can provide immediate feedback after students make changes to related variables in practical activities. PhET Simulations provide interactive experiences for students to attract students' interest in carrying out hybrid learning or fully online learning [18]. PhET can attract the attention of students to take part in classroom learning, and students not only imagine abstractly the concepts taught by the teacher [19].

The lowest response was in the statement that PhET Simulations helped students' discussion activities, which was 69% in the sufficient category. It was related to the results of indirect observations made by researchers on group discussion activities carried out by students through WhatsApp groups. Students tend to be passive in group discussion activities. Most students do not have a social attachment to their classmates

because, so far, they have never had direct interaction due to the policy of limiting social activities during the Covid-19 pandemic. However, before the pandemic or when students were in offline learning, students gave good responses in the group discussion activities [20]. It has been shown that the lack of students' social activities due to online learning affected group discussion activity.

Based on 15 statements that were asked of students, none of them had a percentage in the less category, and only one aspect of the response got the sufficient category. However, the score is still close to the good category, with 69%. The average response of students who showed a fairly good response showed that students were motivated during the virtual laboratory practicum using PhET Simulations. The other research got a similar result that 56,40% of students gave very good responses, and 43,30% of students gave good responses [21]. And it is in line with the N-gain result of students learning outcomes in the medium category. It has shown that students' motivation is related to their learning outcomes, students motivation can increase students learning outcomes [22]. Students with high motivation will have initiative, independence, and discipline and will play an active role in learning and practicum activities [23]. PhET Simulations are considered to be able to be used to carry out virtual laboratory practicums during the Covid-19 pandemic. PhET Simulations provide new experiences and facilities for students to carry out practicals to investigate science concepts. PhET Simulations can also increase students' motivations and understanding of science concepts [24].

CONCLUSION

This study shows how students respond to using PhET Simulations during virtual laboratory practicum activities carried out during hybrid. Students gave a positive response to the use of PhET Simulations, such as students assuming that PhET Simulations were a new thing that aroused interest in students. Students also feel that PhET Simulations can provide new information related to learning materials and can be effectively used to study the material. However, students showed a less positive response regarding how PhET Simulations can support group learning activities online and hybrid. Further research is that discussion activities are more supervised and directed so students can be more active in group discussions. The research results are expected to be a reference for science teachers.

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