



Evidence from SMA Students' Performance on the Impact of Physics Education Technology (PhET) Simulations

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Abstract

The goal of this study is to ascertain whether simulations created using Physics Education Technology (PhET) may enhance SMA students' performance on particular physics topics. The performance of SMA high school students on a chosen physics topic, specifically electrodynamics, can be improved using (PhET) simulation. The performance of SMA students on a chosen physics topic, namely electrodynamics, was examined in this study using a quasi-experimental methodology. In this study, 72 SMA students participated in a quasi-experimental design with multiple-choice pre- and post-tests. The division of the class into two parts—one for the control group and the other for the experimental group—was done based on the sections that the students were in. Every day during their spare time, the experimental group was permitted to play the PhET simulation for an hour, whereas the control group received no exposure to any supplemental activities that would have caused the experiment to be successful. ideas in electrodynamics are formalized through production. Despite the students' apparent interest in the simulation, the results revealed that there was no statistically significant difference between the control and experimental groups' mean scores. Perhaps the simulations that they had experienced throughout the lectures piqued students' interests further. The study also revealed that there was not necessarily a significant difference between students' performance before and after exposure to the PhET simulation, but rather a slight improvement.
Keyword: Education Technology, PhET simulation, Physics Education.

1. Introduction

Due to its sophisticated and abstract nature, physics is one of the high school courses in which pupils show the least enthusiasm [1]. Complex and ethereal describe it. The Philippines' physics education system is in need of improvement, as has been noted. The Philippine education system is quite concerned about this situation where the difficulties lead to poor academic performance [2]. The absence of equipment in physics classrooms is one of the problems. Interventions on how to pique students' interest in physics education more purposefully should be made in light of this. Highlights the fact that standard classroom presentations of concepts don't always help students understand them, and that more has to be done to spark their interest in physics through meaningful learning interventions [3]. It focuses on the idea that standard classroom demonstrations of concepts don't help students learn concepts very well, and that learning should be more effective when there is interaction[4].

Due of difficult challenges, students' performance in physics is currently falling. According to various studies and research conducted by various academics, student performance has been



dropping in the subject of physics, which is the basis for this pattern [5]. The issue for science educators is to come up with or come up with new techniques to make teaching and learning engaging. In Physics, there is a situation that needs to be addressed by teachers [6]. In order to improve students' performance in the subject, physics educators should devise strategies and interventions [7].

The majority of research shows how the use of educational resources can improve student learning[8]. Effective knowledge transfer and acquisition and skills development are demonstrated with the use of laboratory manuals and learning modules, computer-assisted instructional systems, and other digital technologies. Improving achievement levels in K-12 schools in the Philippines is a major concern, according to (Batuyong & Antonio, 2018). This is due to integrating ICT-supported education in the teaching-learning process[9]. In fact, a study on computer-assisted learning revealed that junior and senior high school students who were exposed to technology outperformed those who were not. In the study, it was found that educational materials using technology can inspire students' imagination, and showed how technology can inspire students' imagination while fostering a more motivating learning environment. More options for communication between teachers and students have also been shown to exist because of technology[10].

Information and communication technology's (ICT) extensive use is growing in the modern day[11]. ICT can be employed in science instruction because it bridges the gap between the processes of teaching and learning. Computer simulations for physics, or Physics Education Technology, are one potential innovation that improves learning (PhET) [12]. Science learning is thought to be facilitated through PhET simulations, which are regarded as a potent tool. The necessity for building a constructual framework of scientific understanding can be addressed by integrating PhET in the classroom [13]. Computers and other instructional materials related to computers can improve student performance, according to research on computer-assisted instruction. As a result, using computer simulations can help students do better in Physics classes. PhET simulations in this context The use of PhET simulations can help students perform better [14].

2. Research Method

In order to ascertain the major impact of PhET simulation on the students development in their learning, the research study used a quasi-experimental design with pre-test and post-test assessments [15]. The data set was described using certain descriptive statistics. Additionally, the significance of the improvement in student performance or the significant impact of the PhET simulation on learning was assessed using the T-test for significant difference for the inferential statistics.

72 high school seniors who are enrolled in the 12th grade are the study's participant students. Cluster sampling in accordance with the sectional grouping will be employed as the selection method. Two groups were chosen: the experimental group and the control group, each of which consisted of 40 high school pupils (32 high school students). To account for the enhancement in learning brought about by the use of PhET simulation, pre- and post-tests were given to both groups.

Multiple-Choice Test questionnaires were the research tool, and checking was made easier by using the Zipgrade application. The book *Practicing Physics Conceptual Physics* served as the source for the questions utilized in the pretest and posttest. An aspect of the physics course that was being tested was conceptual knowledge of electrodynamics [16]. Before the deployment of the PhET simulation, both the control and experimental groups took a pre-test to gauge their level of learning. The students' empty calendars were used for the PhET simulation during the intervention, and a post-test was given to see whether the students' conceptual understanding had changed. Knowledge of the subject under examination. None of the treatment or intervention was given to the control group [17]. After the lesson discussion using the standard teaching method, the intervention and post-test were given. This means that the blank schedules for the control pupils were not used. Moreover, before being exposed to the simulation, those student groups won't participate in any lectures or other similar activities that would have given them the chance to create ideas [18].

The pre-test, post-test, and posttest of the experimental group were compared to the post-test of the control group using the Paired and Independent T-test for data analysis. The

post-test of the control group and the pre-test and post-test of the experimental group were both compared using the Paired and Independent T-tests, respectively, to determine whether there were any statistically significant changes [19]. In keeping with this, descriptive statistics that characterize the mean, standard deviation, minimum and maximum values, as well as other aspects of the data collection, were also included.

3. Findings

3.1 Problem

The goal of this study, at its conclusion, was to discover whether the intervention—PHET simulation—had a substantial positive impact on students' grades. The findings of this study will be applied as an empowering tool to raise student achievement levels in Science. This study's main goal is to determine whether PhET simulation may help SMA students do better academically on a few specific physics courses[20]. These goals are specifically covered by this study 1) to compare the academic performance of high school pupils receiving PhET simulation intervention to those receiving no intervention; and (2) to find out whether there is a discernible difference in students' performance when using the PhET simulation versus when not. Additionally, unassisted. The beneficiaries of this study include those who have been identified as following: a) students, b) teachers, c) administrators of the school. Students will be able to learn Physics principles through the use of PhET simulations, which will improve their comprehension of the subject's concepts. By using virtual simulations that may be implemented in the classroom, teachers will spend less time creating activities that are already available. The equipment needed to give pupils with greater learning opportunities won't need to be purchased by school administration. When it comes to improving student performance, this research will be pertinent because it will benefit the students. Insofar as it raises student achievement and, consequently, the Mean Percentage Score (MPS), particularly in science, the research will be relevant [21].

3.2 Research Implementation

Pre-test and Post-test Score Descriptive Statistics

Table 1. shows descriptive data for the pre- and post-test results for the control and experimental groups.

Descriptive Statistics	Control Group (n=40)		Experimental Group (n=32)	
	Pre-test	ost-test	Pre-test	Post-test
Mean	3.33	3.70	3.43	3.97
Std. Dev.	0.2069	0.2562	0.2616	0.2176
Minimum	1	1	1	2
Maximum	6	8	7	8

Note: Highest possible score is 10

T-test Analysis

Table 2. menunjukkan hasil uji-t statistik untuk skor rata-rata kelompok eksperimen dan kelompok kontrol.

Variables	T-computed	df	p-value
Control vs Experimental	-0.7995ns	70	0.2133

Note: ns-not significant.

Table 3. shows the outcomes of a statistical test for the mean scores of the experimental pre-test and post-test.

Variables	T-computed	df	p-value
Pre-test vs Post-test	-1.745*	31	0.045

Note: *- significant at 5% level

To examine the nature and traits of the research data, descriptive statistics were used

as a first step. It was able to compare result values that would imply relative differences because of the data's descriptive character [20], [21]. It can be seen from Table 1 that both the experimental group and the control group had low means, which suggests that the students had a difficult time with the physics test and that they encountered several difficult difficulties. The experimental group's posttest results ranged from 2 to 8, with 8 being the highest possible score, and 2 being the lowest possible score. This implies that some students considered the test to be challenging and that the PhET interactive simulation had minimal impact on their academic performance. Furthermore, the mean scores demonstrate that the pre-test and post-test only slightly deviate from one another. The study's findings indicating the PhET interactive simulation had little impact on students' success levels are in conflict with this result. After the introduction of the PhET, the pupils' academic performance significantly increased [22]. The intervention's execution was badly impacted by a number of variables, including the difficult problems that students might encounter, which contributed to the low performance.

The experimental group's pre-test and post-test means underwent additional statistical analysis, the results of which are displayed in Table 3. It is noted that the t-test result shows a minor significant difference, despite the fact that it is obvious that there is a big deviation in their means. Furthermore, the majority of the respondent's scores fall below the passing mark, which further suggests that the intervention done did not necessarily change how the students thought about physics conceptually [23].

However, it is important to point out that students were enthusiastic and inventive when exploring the various physics simulations throughout the PhET simulation administration. They were told to research and play simulation games that dealt with the ideas of electricity and magnetism, but they often go further than they were told to. They were curious to learn more about how simulations connected to the physics topics they had studied in class would be explained. Observations made during the activity show that the students' exploration of PhET is more focused on the ideas they already know, as seen by their increased exploration of physics topics related to mechanics. The restrictions placed on them regarding the amount of simulation coverage that they should be exposed to have students acting ironically [24].

It should be emphasized that students are interested in computer simulations even though the test results showed minimal difference between the experimental and control groups' pre-test and post-test scores. According to research, having a healthy interest in learning might increase academic success and learning satisfaction. The use of PhET by physics instructors can help them refine their classroom management techniques, which is crucial. On the other hand, these simulations are not helpful in helping physics students formalize their thoughts, depending on the outcomes of the simulations. This is because the several terminology used in the simulation are confusing to students. According to the findings, it is essential that students first participate in lectures or other activities where the many terms related to the simulation can be explained. Due to the fact that students are more likely to explore simulations they have already experienced in lectures, this assertion is accurate. Also crucial to consider is the possibility that students' interest in investigating the predetermined simulations was influenced by the lack of interruptions from lectures and other associated activities that would have prompted conceptual understanding in the students. Another finding is that despite their formal nature, physics-related information or concepts may not always be able to be constructed in a formal way using PhET simulations. The simulation instead tests previously learned concepts utilizing the simulation's virtual laboratory environment, without necessarily encouraging the production of formal structures of knowledge or ideas linked to physics. In conclusion, this discovery is validated in According to a study, high school students' learning experiences from using PhET simulations may be categorized into three main themes, which lends weight to this conclusion [25]. There are three main themes: It's entertaining, real, easy, and straightforward to study physics.

4. Conclusion

According to the findings, students' conceptual assessments in electrodynamics have

slightly improved thanks to PhET simulation. To put it another way, this study's methodology shown that PhET simulations can somewhat enhance academic achievement in SMA physics. In conclusion, there was a slight difference in the academic performance of students exposed to PhET simulations compared to students who were not exposed to them, showing that PhET simulations are helpful at raising students' academic achievement in physics. According to the findings, PhET simulations are a useful tool for teaching and raising students' proficiency levels in the topic of physics. Thus, space for future development and an increase in Physics Education Technology should be provided for Physics teachers (PhET). a more advanced degree of application of Physics Education Technology (PhET) to more effectively accomplish the educational goals that the Department of Education (DepEd) wants for the welfare of students. High school pupils appear to be enjoying themselves as they put the PhET simulation into practice. In order for students to study physics while enjoying themselves, physics teachers should maintain and improve the activities offered in the PhET simulation.

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