

Impact of Video Game Based Instructional Strategy on Students' Interest and Conceptual Understanding of Senior Secondary School Physics

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Abstract: The aim of this study was to examine the effect of video game based instructional strategy on students' conceptual understanding and interest of senior secondary school physics, the research used a pre-test, post-test, control group quasi-experimental design, the population of the study comprises three hundred and eighty three (383) Physics students at public, co-educational senior high schools who are in SS 2 in Dutsin –Ma Educational quality assurance Zone. Two (2) co-educational schools were selected using simple random sampling technique the sample consists of one hundred and four (104) SS 2 students, 52 for experimental sample and 52 for control sample. Each of the two schools used a whole science class. Two instruments were used for the study which are: Physics conceptual understanding Test (PCT) and Physics Interest Scale (PIS) with the reliability and internal consistency of 0.781 and 0.784 respectively. The instruments were used to collect data for students' conceptual understanding and interest respectively. Mean and standard deviation were used to answer the research questions, and a t-test independent sample was used to test the hypotheses at 0.05 level of significance. The outcome showed that the video game based instructional strategy is superior to the teacher-centered method in fostering conceptual understanding and interest among the students. On the basis of these, certain recommendations are suggested which include; teachers of senior secondary schools should expose Physics students to video game based instructional strategy, in order to promote their conceptual understanding of physics concepts, Science teachers should incorporate the use of virtual reality based instruction to complement their traditional chalk-talk method of instructional delivery to make students developed interest in the subjects.

Keywords: Video Game, Conceptual Understanding, Interest and Physics

1. Introduction

Physics is a branch of natural science that investigates matter, its motion and behavior in space and time, as well as the relationships between energy and force. Among the many fields where physics is used directly or indirectly are electrical engineering, electronics, telecommunications, building, architecture, traffic, mechanical engineering, technology, veterinary medicine, pharmaceuticals, chemistry, biology, agriculture, military expertise, mining, forestry, meteorology, astronomy, economy, philosophy, sociology, and psychology. Furthermore, physics has a number of laws, concepts, and theories that require a thorough understanding

in order to be appreciated and implemented in everyday life. This necessitates physics teachers use a variety of ways to accommodate students' conceptual understanding. Despite this, the majority of senior high school physics teachers teach the subject using the lecture (conventional) style.

Nonetheless, the current system is examination-driven [15]. Many physics teachers use rote learning, which has a negative impact on students' abilities and hampers the development of conceptual understanding in all courses, including physics [5]. Improving students' conceptual understanding has become a hot topic in recent years [9]. However, numerous factors, including internal and external ones from the students, contribute to students' poor

performance and conceptual comprehension of Physics [2]. Examples of internal components include mindset, drive, interest, information, expertise, optimism, assumptions, and goals. [2, 15], whereas the external aspect is the student's learning environment [2]. External determinants include instructors' use of instructional methods, [3] but Felder, and Brent, (2015) list family environment, as well as the availability of learning facilities and infrastructure. Students' interest in the material presented is one of the internal elements determining conceptual understanding and study achievement. When a student is interested in getting to know, he or she is more likely to get good results. In contrast, if there is little interest, the study's outcome will be poor [1, 10].

Interest is a sensation or emotion that causes one's attention to be drawn to a certain object, event, or activity. It is a term that is used to describe a broad concept that can include other more specific psychological terms like curiosity and, to a lesser extent, surprise [7]. According to Nworgu, (2006) Interest is a persistent desire to pay consideration to and take pleasure in certain actions or materials. "A subjective-objective attitude, concern, or situation involving a perception or an idea in attention and a combination of intellectual and sensation of consciousness, founded on natural curiosity, conditioned by experience,"[14]. However, in the teaching and learning of physics, enthusiasm is a critical aspect. The degree and direction of students' attitudes about physics is largely controlled by their level of interest in the subject.

Because physics concerns objects that cannot be seen or interacted with, most physics students regard the subject as abstract and difficult. If teachers can construct an environment that allows students to interact with such items, they will have a conceptual understanding of physics rules and will be able to apply them in real-life situations. In such instances, technology has the ability to make a positive effect. Physics professors, on the other hand, can accomplish so by utilizing new technology such as computer games and simulations.

According to Putra, and Setyaningrum, (2019) one way to make learning more enjoyable is to use the Game-Based Learning (GBL) method. According to Sousa, and Rocha, (2019), game-based learning is a notion that is designed around a learning process that uses a specific game as the major pedagogical tool to assist create and develop skills. Digital games, according to [16], Portals 2 was the video game employed in this research. The game engine is built to obey Newton's Laws and the kinematics that occur, indicating that the game could be used to teach these fundamental physics topics [4]. Computer games are quite popular in today's society [16]. Many people, particularly young people, have a lot of experience learning the rules of different game worlds and love it. In some situations, such as the first-person shooter genre, portals, and portals 2, understanding the physics of the simulated environment through experimentation is included, will this experience aid in the learning of physics, improve students' conceptual understanding of physics laws, and pique their interest in the subject? Computer simulations can be used to supplement standard teaching methods by simulating novel physics [12].

However, students' conceptual understanding of Physics will not increase unless teachers use appropriate teaching methods and procedures. In today's world, where computer games are widespread and widely available, the employment of new technologies such as virtual reality-based educational strategies that include games and simulations, among other things, may have a helpful impact on conceptual understanding of students. Based on these findings, the researcher wanted to see how video game-based instructional strategies affected students' interest and conceptual comprehension in senior secondary school physics in the Dutsin-Ma educational quality assurance zone.

1.1. Objectives of the Study

The study's goals are listed as follows:

- 1) To compare the experimental and control groups' conceptual comprehension of physics prior to treatment.
- 2) To look into the disparity in physics interest between the experimental and control groups prior to treatment.
- 3) To compare the conceptual understanding of physics between students who were taught using a technique based on video games and those who were taught using a teacher-centered approach.
- 4) To examine the effect of video game based instructional strategy on interest of students in Physics.

1.2. Research Questions

The study's research questions are as follows:

- 1) What was the mean difference in physics conceptual comprehension between the experimental and control groups prior to treatment?
- 2) What is the mean difference of interest in physics before treatment, between the experimental and control groups?
- 3) What is the mean difference in students' conceptual understanding of physics between those that exposed to video game-based educational technique and those who were taught using a teacher-centered mode of instruction?

1.3. Research Hypotheses

The study's Hypotheses at 0.05 level of significance are as follows:

Ho₁: No significant difference exists in conceptual understanding of physics between the experimental and control groups before treatment.

Ho₂: No significant difference exists in interest on physics between the experimental and control groups before treatment.

Ho₃: No significant difference exists between the students' conceptual understanding of physics when exposed to video game based instructional technique and those that taught using teacher-centered mode of instruction.

Ho₄: No significant difference exists difference between the students' conceptual understanding of physics when exposed to video game based instructional strategy and those that taught using teacher-centered mode of instruction.

2. Research Methodology

This section explains the design of research, the population, sampling and sampling technique, instruments and method of data analyses.

2.1. Research Design and Population

The design for this study adopted a quasi-experimental design. The population of the study comprises three hundred and eighty three (383) SS 2 physics students in public co-educational senior secondary schools in Dutsin –Ma Educational quality Assurance Zone comprises two hundred and fifty eight (258) males and one hundred and sixty six (166) females with an average age of 16 to 17 years.

2.2. Sampling and Sampling Technique

Two (2) co-educational schools were selected using simple random sampling; out of the eleven (11) co-educational schools in Dutsin-Ma Educational Zone. The schools selected randomly were G.S.S.S Darawa and G.P.S.S.S Dutsin-Ma. G.S.S.S Darawa was randomly assigned as experimental sample while G.P.S.S.S Dutsin-Ma was randomly assigned as the control sample, SS 2 science whole class was used for the study. The sample consists of one hundred and four (104) SS 2 students, 52 for experimental group and 52 for control group. There were 61 males and 43 females in the two sampled schools.

2.3. Instruments

Two instruments were used for the study. These were: Physics Conceptual understanding Test (PCT) and Physics Interest Scale (PIS). The instruments were validated by two

experts from Science education department and one from department of educational foundation both in Federal university Dutsin-Ma.

2.3.1. Pilot Test

A pilot test was conducted to determine the reliability of the instruments on a group of twenty (20) SS 2 science students of Government Secondary School Karofi which is in the population but not in the sample of the study.

2.3.2. Reliability of Instrument

The reliability index computed using Pearson Product Moment Correlation (PPMC) for PCT was 0.781. While the internal consistency of Physics Interest Scale (PIS) was established using Cronbach's Alpha and 0.784 was obtained, which indicates high reliability index of both the instruments and hence the instruments PCT and PIS are reliable.

2.4. Method of Data Analyses

The collected data was analyzed using descriptive statistics of standard deviation and mean to answer the four (4) research questions, and independent sample of t-test was used to test all the four (4) hypotheses formulated for the study at 0.05 level of significance.

3. Result and Discussion

The results of the study were presented in both the groups. The data was obtained using Physics Conceptual Understanding Test (PCT) and Physics Interest Scale (PIS). The scores of students for both PCT and PIS in both the groups were subjected to descriptive statistics in form of Means and Standard Deviations. This is presented in Table 1.

Table 1. Analysis of Pre-Test and post-test Means and Standard Deviations Scores for PCT and PIS of the Experimental and Control Groups.

Type of scores	Groups	N	Mean	SD	Std. Error	Mean Difference
Pre- test for PCT	Experimental	52	7.73	1.402	0.194	0.06
	Control	52	7.79	1.226	0.170	
Pre- test for PIS	Experimental	52	32.67	1.402	0.593	0.33
	Control	52	33.00	1.226	0.704	
Post- test for PCT	Experimental	52	18.12	3.422	0.475	7.00
	Control	52	11.12	2.579	0.358	
Post- test for PIS	Experimental	52	45.21	4.141	0.574	7.08
	Control	52	38.13	4.284	0.594	

Table 1 revealed that the pre-test standard deviations and of students means for PCT scores in the experimental Group were 7.73 and 1.402 and that of control group were 7.79 and 1.226. The pre-test mean score difference was 0.06. It also revealed that the pre-test means and standard deviations of students for PIS in the experimental Group were 32.67 and 1.404 and that of control group were 33.00 and 1.226. The pre-test mean score difference was 0.33.

Furthermore, the above table revealed that the post-test standard deviations and means of students for PCT in the experimental Group were 18.12 and 3.422 and that of control group were 11.12 and 2.579. The post-test mean score difference was 7. It also revealed that the post-test standard deviations and means of students for PIS in the experimental

Group were 45.21 and 4.141 and control group were 38.13 and 4.284. The post-test mean score difference was 7.08.

This section analyzed data using statistical tools to test the four (4) null hypothesis formulated for the study, using Independent sample of T-test at 0.05 level of significance. The data were subjected to test of normality and found to be normally distributed, before proceeding to the testing of hypotheses.

Hypothesis one

Ho₁: No significant difference exists in conceptual understanding of physics between the control and experimental groups before treatment.

In order to test hypothesis one the pre-test scores in the control and the experimental groups for PCT were subjected

to T-test of independent sample statistics. Summary of the analysis was presented in table 2.

Table 2. T-test analysis of the Pre-Test Mean Scores for PCT of the Experimental and Control Groups.

Groups	N	Mean	SD	df	T-value	P-value
Experimental	52	7.73	1.402	102	-.223	.824
Control	52	7.79	1.226			

Table 2 revealed that the T-value computed was -.223 and the P-value of 0.824 is observed. Since the obtained P-value of 0.824 is greater than the alpha value of 0.05, hence the study retained the null hypothesis one (1) that says no significant difference exists in conceptual understanding of physics between the control and experimental groups before treatment. This indicates that both experimental and control groups were on the same level of conceptual understanding of physics before treatment.

Hypothesis two

Ho₂: No significant difference exists in the interest of physics between the control and experimental groups before treatment.

In order to test hypotheses two the pre-test scores in the control and the experimental groups for PIS were subjected to T-test of independent sample statistics. Summary of the analysis was presented in table 3.

Table 3. T-test analysis of the Pre-Test Mean Scores for PIS of the Experimental and Control Groups.

Groups	N	Mean	SD	Df	T-value	P-value
Experimental	52	32.67	4.278	102	-.355	.723
Control	52	33.00	5.076			

Table 3 revealed that the T-value computed was -.355 and the P-value of 0.723 is observed. Since the obtained P-value of 0.723 is greater than the alpha value of 0.05, hence the study retained the null hypothesis two (2) that says no significant difference exists in the interest of physics between the control and experimental groups before treatment. This indicates that both experimental and control groups were on the same level of interest in physics before treatment.

Hypothesis three

Ho₃: No significant difference exists between the students' conceptual understanding of physics when taught using video game based instructional strategy and those that taught using teacher-centered method of teaching.

In order to test hypotheses three, the post-test scores in the control g and the experimental groups for PCT were subjected to T-test of independent sample statistics. Summary of the analysis was presented in table 4.

Table 4. T-test analysis of the Post-Test Mean Scores for PCT of the Experimental and Control Groups.

Groups	N	Mean	SD	Df	T-value	P-value
Experimental	52	18.12	3.422	102	11.779	0.000
Control	52	11.12	2.579			

Table 4 revealed that the T-value computed was 11.779 and the P-value of 0.000 is observed. Since the obtained P-value of 0.000 is less than the alpha value of 0.05, Based on

the decision rule, this study rejected the null hypothesis three (3) that says no significant difference exists between the students' conceptual understanding of physics when exposed to video game based instructional strategy and those that taught using teacher-centered mode of teaching. The decision implies that, a significant difference exist in the mean score of Conceptual understanding of Physics between those exposed to video game based educational technique and those taught using teacher-based mode of teaching. This indicates that the students of experimental group performed significantly better than those in control group in conceptual understanding of physics.

Hypothesis four

Ho₄: No significant difference exists between the interest of physics students taught using video game based educational technique and those that taught using teacher-centered mode of teaching.

In order to test hypothesis four, the post-test scores in the control and the experimental groups for PIS were subjected to T-test of independent sample statistics. Summary of the analysis was presented in table 5.

Table 5. T-test analysis of the Post-Test Mean Scores for PIS of the Experimental and Control Groups.

Groups	N	Mean	SD	Df	T-value	P-value
Experimental	52	45.21	4.141	102	8.565	0.000
Control	52	38.13	4.284			

Table 5 revealed that the T-value computed was 8.565 and the P-value of 0.000 is observed. Since the obtained P-value of 0.000 is less than the alpha value of 0.05, hence the study rejected the null hypothesis four (4) that says no significant difference exists between the interest of physics students taught using video game based educational technique and those that taught using teacher-centered mode of teaching. The decision implies that, a significant difference exists in the mean score of interest in Physics between those exposed to video game based instructional strategy and those taught using teacher-based mode of teaching. This indicates exposed to video game based instructional strategy performed significantly better than those taught using teacher-based mode in interest of physics.

4. Conclusions

The following conclusions were drawn based on the results of this research:

- 1) Both control and experimental group were on the same level of conceptual understanding of physics before treatment.
- 2) Both control and experimental group were on the same level of interest in physics before treatment.
- 3) Video game based instructional strategy enhances the student's conceptual understanding of Physics concepts among senior secondary school students under study.
- 4) Video game based instructional strategy enhances the student's interest in Physics concepts among senior secondary school students under study.

5. Recommendations

The following recommendations were made, based on the results of this study:

- 1) Teachers of senior secondary schools should expose Physics students to video game based instructional strategy, in order to promote their conceptual understanding of physics concepts.
- 2) Science teachers should incorporate the use of video game based instructional strategy to complement their traditional chalk-talk method of instruction to make students developed interest in physics and other science subjects.

References

- [1] Ben, F. (2010). Students Uptake of Physics: A Study of Australian and Filipino Physics Students, School of Education, Faculty of the Professions, University of Adelaide.
- [2] Carbone, A., Hurst, J., Mitchell, I., & Gunstone, V. (2009). An exploration of Internal Factors influencing student learning of programming, in Proceedings of the 11th Australasian Computing Education Conference (ACE '09), vol. 95 of Conferences in Research and Practice in Information Technology, pp. 25–34, Australian Computer Society, Wellington, New Zealand, January.
- [3] Changeiywo, M., Wambugu, P. & Wachanga, S. (2011). Investigations of Students' Motivation towards Learning Secondary School Physics through mastery learning approach, International Journal of Science and Mathematics Education, vol. 9, no. 6, pp. 1333–1350.
- [4] Crouch, I. (2014). Effect of Virtual Reality on Student's Understanding on and interest of Physics (unpublished). Masters Dissertation Michigan technological university.
- [5] Djamarah, S. (2002). Teaching Learning Strategy, Rineka Cipta, Jakarta, Indonesia.
- [6] Felder, R. & Brent, V. (2005). Understanding Student Differences, Journal of Engineering Education, vol. 94, no. 1, pp. 57–72.
- [7] James, P. (2016). A Look at NASA's Hybrid Reality Astronaut Training System, Powered by HTC Vive – Road to VR. Road to VR. Retrieved 2017-03-15.
- [8] Nworgu, B. (2006). Educational research; basic issues and methodology. University Trust Publishers, Nsukka, Enugu.
- [9] Office for Standards in Education. (2008). Mathematics: Understanding the score. Office for Standards in Education. London.
- [10] Olusola, O. & Rotimi, C. (2012). Attitudes of students towards the study of physics in College of Education Ikere Ekiti, Ekiti State, Nigeria, American International Journal of Contemporary Research, vol. 2, no. 12, pp. 86–89.
- [11] Putra, W. & Setyaningrum, W. (2019). The effect of game-based learning toward conceptual understanding. International Conference on Mathematics and Science Education, doi: 10.1088/1742-6596/1157/4/042117.
- [12] Savage, C., McGrath, D., McIntyre, T., Wegener, M., & Williamson, M. (2000). Teaching Physics Using Virtual Reality, Centre for Learning and Teaching in the Physical Sciences.
- [13] Sousa, M. & Rocha, Á. (2019). "Skills for disruptive digital business," Journal of Business Research, Elsevier, vol. 94 (C), pages 257-263.
- [14] Tyokasu, J. (2003). Attitude of teachers toward, the Teaching of Economics in Secondary School in Konshisha Local Government Area, Benue State. An unpublished Ph.D Thesis, University of Nigeria Nsukka.
- [15] Wulan, S. (2012). Effect of learning model and personality type towards learning achievement of student in private junior high school in the Medan Area Sub-District, Tabularasa Journal, Post Graduate Programe of Medan State University, vol. 9, no. 1, Ben, F. (2010). Students Uptake of Physics: A Study of Australian and Filipino Physics Students, School of Education, Faculty of the Proffesions, University of Adelaide, pp. 33–44.
- [16] Chwen Jen, C. (2016). Theoretical bases for using virtual reality in education Themes in Science and Technology Education. pp. 71-90.