EFFECT OF VIRTUAL REALITY-BASED INSTRUCTIONAL STRATEGY ON SECONDARY SCHOOL STUDENS IN PHYSICS IN DUTSIN-MA EDUCATIONAL QUALITY ASSURANCE ZONE, KATSINA STATE

BY

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Abstract
This study was conducted to examine the effect of Virtual reality-based instructional strategy on Secondary School Students' Interest in Physics. The study employed a quasi-experimental design adopting pre-test and post-test control group design. The sample for the study comprises one hundred and seventeen (117) SSII physics Students. The study was conducted in two public co-educational secondary schools in Dutsin-Ma. The schools were selected using simple random sampling, in each of the two schools, intact science class was used. The instrument used was Physics Interest Scale with internal consistency of 0.784. The research questions were answered using mean and standard deviation while the hypotheses were tested at (P<0.05) using t-test independent sample. The result revealed that virtual reality-based instruction enhances the students' interest in Physics concepts among senior secondary school students under study. It also revealed that virtual reality-based instruction is a gender friendly instructional strategy with respect to the interest, recommendations were made which are; Science teachers should incorporate the use of virtual reality-based instruction to complement their traditional chalk-talk method of instructional to make students developed interest in physics and other science subjects. And the educational stakeholders should encouraged physics teachers to use virtual reality-based instruction in teaching the subject in order to improve the interest of both male and female students in the subject.
Keywords: Virtual Reality, Interest, Secondary School Students, Physics

Introduction

Physics is one of the most fundamental science disciplines. It's a natural science that studies matter, its motion and behavior through space and time, and that it studies relate entities of energy and force. Physics is one of the oldest academic disciplines and by virtue of its inclusion of astronomy; it is perhaps the oldest (Krupp, 2003).Physics deals with study of matter and energy. The application of physics is directly or indirectly unavoidable in electrical engineering, electronics, telecommunications, construction, architecture, traffic, mechanical engineering, technology, veterinary medicine, pharmaceutics, chemistry, biology, agriculture, military skills, mining, forestry, meteorology, astronomy, economy, philosophy, sociology, psychology among others. Almost every life field has some relation with Physics like organisms or inanimate, from Engineering to Mathematics, Biology, and Chemistry (Ukoh, 2012). Without Physics science knowledge, man will face difficulties in exploring the universe (Ghozali, 2001).

Furthermore, understanding of Physics helps to understand the content of universe. For students, it helps to develop the observation skill, accuracy, analysis ability and creative thinking (Mekonnen, 2014). Acquisition of Physics science knowledge, which is now very required, cannot be avoided by students (Ukoh, 2012).

Royer (2000) (as cited in Sunday, 2007) perceived interest as modes of emotional regard for objects and motor set's or slight tentative reactions toward them. It involves a tendency to act towards or against something in the environment which becomes thereby a positive or negative value. It therefore involves the predisposition of individuals to evaluate some symbols or objects of the scientific domain a favorable or unfavorable manner (Ugwuanyi, 2015). Smith (2010) conceptualized interest in relation to experience. According to Smith interest is a predisposition to experience to be motivated by, and to act towards, a class of object in a predictable manner. Sunday (2007) sees interest as indispensable for learning and that many held the view that there can be no real education without interest. Interest research has shown that students will engage in science learning activities and, moreover, choose science courses in upper secondary school if they are interested in the topics to be learned (Hidi, Renninger & Krapp, 2004).

Historically, science has been portrayed as a masculine pursuit in which women have faced significant barriers to participate (Eisenhart and Finkel, 2000). Even after universities began admitting women in the 19th century, women were still largely relegated to certain scientific fields, such as home science, nursing, and child psychology. Women were also typically given tedious, low-paying jobs and denied opportunities for career advancement (Ashok, 2005). This was often justified by the stereotype that women were naturally more suited to jobs that required concentration, patience, and dexterity, rather than creativity, leadership, or intellect. Although these stereotypes have been dispelled in modern times, women are still underrepresented in prestigious "hard science" fields such as physics, and are less likely to hold high-ranking positions. (Ashok, 2005)

In search of an answer for the globally alarming situation, many science educators have given greater importance to the affective domain, especially attitudes and interests. Students' originally positive attitudes toward science subjects change markedly in the upper grades, especially in chemistry and physics (Abdulgafoor, 2013). Studies indicate that students' interest in physics declines during secondary stage and those girls are less interested in physics than boys (Abdulgafoor, 2013). Students considered physics and chemistry to be the most difficult of science courses, and generally more difficult than most other subjects (Lyons, 2004). Hoffmann (2002) revealed that girls find physics less and less interesting as they grow older; and, by the end of the 5th grade, well before the majority of classes begin to study physics, girls generally show markedly less interest than boys in most of the areas of physics. Moreover, girls generally regard physics as belonging to the group of the least interesting subjects; and, boys to those that are the most interesting. Distinct reduction in interest in the majority of areas in physics, more marked in girls than in boys, was seen in the 7th grade when the majority of classes begin to study physics (Hoffmann, 2002).

In a study conducted by (Gafoorm, 2009) also shows that, gender difference in physics learning is reported. Out of the 63 concepts in Physics that show gender difference in misconceptions, 37 concepts have higher rate of misconception among girls than boys. Only 26 concepts in Physics have higher rate of misconceptions among boys, than in girls (Abdulgafoor, 2013). Girls in primary classes expressed more interest in studying further school science topics than the boys; by high school the level of interest amongst the girls dropped considerably so that the girls who had greatest primary science experience now gave the lowest response to questions about interest in future school science topics (Abdulgafoor, 2013).

Bamidele (2004) observed lack of interest in physics by students due to preconceived idea that physics is a difficult subject has affected the enrolment and performance of students in physics (Kola and Taiwo,

2013). The poor performance physics is no gender exception it cut across both male and female but it is very important to find out the level of failure between male and female for proffer adequate solution to it. Effect of gender on school science cannot be overemphasized as observed by Bello (2002) that gender difference is characterized by female underrepresentation and underachievement in science (Kola and Taiwo, 2013). A distinction between general interest in physical matters and interest in physics as a school subject is possible (Hoffmann, 2002). General interest in physical matters is as individual interest in physics, an enduring personal disposition to engage with different areas of physics (Krapp, Hidi, & Renninger, 2000). According to them, interest in physics as a school subject is a combination of individual interest in physics, and short-term interest in certain topics of physics produced by instructional factors.

Most physics students see it as an abstract and a difficult subject because it involves objects that cannot be seen and interact with. If teachers can create environment that can make those students to interact with those objects they would have a conceptual understanding of physics laws, know how to apply them in everyday life and put interest to it. Technology has the potential to bring an optimistic difference in such situations. Many countries (Nigeria inclusive) are nowadays seeking to develop their education systems through the use of technologies and methods of modern learning in order to keep pace with technological developments and to achieve satisfactory results, as education is considered a real investment for any country and its people (Crouch, 2014). This involves making good use of the technology in preparing students, teachers, curriculum development and the diversity of teaching methods, in an attempt to develop the educational process and to provide better learning and education (Crouch, 2014).

However for physics teachers this can be done by using such new technologies available as computer games and simulations. Computer games occupy a central place in society (Chwen Jen, 2014). Many people, especially young people, have a great deal of experience learning of the rules of game worlds and they enjoy it. In some cases, such as the first-person-shooter genre, portals, portals 2, among others include learning of physics of the simulated world through a process of experimentation (Savage, Grath, McIntyre, Wegener and Williamson, 2000). Will this experience helps students learn physics, enhance student's conceptual understanding of physics laws and arouse their interest? Computer simulations can complement traditional approaches to teaching by providing simulated experiences of unfamiliar physics (Savage, et al, 2000).

To keep up with this rapid growth, it is clear that educational researchers need to begin exploring the impact these technologies could have in our classrooms and on teaching learning in general (Crouch, 2014). According to Crosier, Cobb & Wilson (2001) the technology that uses computer games and simulations and virtual world in teaching and learning process is called virtual reality based instruction. The possibility that Virtual Reality (VR) may be a useful technology to apply in teaching and learning has generated interest in the design and development of Virtual Reality applications for schools (Crosier, Cobb & Wilson 2001). Virtual Reality provides several unique attributes that set it apart from other computer technologies currently used in schools. Among these are: the ability to visualize and manipulate objects that cannot ordinarily be seen in the real world, the facility for exploring dangerous situations and providing a medium for presenting complex three dimensional concepts (Crosier et al, 2001). In addition, there is the potential for motivational advantages of new technology and the opportunity for self-directed `learning by doing' which has been described as a promising learning style (Crosier et al, 2001). Base on this research sort to investigate the effect of virtual reality-based instruction on secondary school students' interest in physics.

Objectives of the Study

1. To examine the difference of interest in physics between the physics students expose to virtual reality based instruction and their counterparts taught using teacher-centered method of teaching.

2. To find out the difference between male and female students interest in physics when exposed to virtual reality based instruction.

Research Questions

The following research questions were answered:

1. What is the mean difference between the interest of physics students exposed to virtual reality based instruction and those that taught using conventional teacher-centered method of teaching?
2. What is the mean difference between male and female students' interest on physics when exposed to virtual reality based instruction?

Research Hypotheses

The following hypotheses were tested at 0.05 level of significance:

Ho_1: There is no significant difference between the interest of physics students exposed to virtual reality based instruction and those that taught using conventional teacher-centered method of teaching.

Ho_2: There is no significant difference between male and female physics students' interest in Physics when exposed to virtual reality based instruction.

Scope and Delimitation of the Study

The scope of this study was all the public secondary schools students in Dutsin-Ma Zonal Education Quality Assurance that offer physics. Senior Secondary School (SS II) students with an average age of 16-17 years were used. Gender differences were also studied in relation to the variables. The virtual reality based instruction used was Portals 2 game.

Methodology

The design for this study was a quasi-experimental design adopting pre-test and post-test control group. The population of the study comprises three hundred and eighty three (383) SS 2 physics students in eleven (11) public co-educational senior secondary schools in Dutsin-ma Educational Quality Assuarance 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.

Two (2) co-educational schools were selected for the sample using simple random sampling; out of the eleven (11) co-educational schools in Dutsin-ma Educational Zone, in each of the school SS 2 science intact class was used for the study. The sample consists of one hundred and seventeen (117) SS 2 students, 65 for experimental group and 52 for control group. There were 61 males and 56 females in the two sampled schools.

The instrument used for the study was Physics Interest Scale (PIS). The instrument was validated by two experts from Science Education department and one from department of Educational Foundation both in Federal university Dutsin-ma. A pilot test was conducted to establish the reliability of the instruments on a group of twenty (20) SS 2 science students of Government Pilot Secondary School Safana which is outside the sample of the study. The internal consistency was established using Cronbach's Alpha whereby 0.784 reliability index was obtained.

The collected data was analyzed using descriptive statistics in terms of mean and standard deviation to answer the two (2) research questions. While t-test independent samples (inferential statistics) was used to test all the two (2) hypotheses formulated for the study at 0.05 level of significance.

Result

In order to answer the research questions the scores of both experimental and control groups and that of male and female students of experimental group were subjected to descriptive statistics and the result is presented below.

Research Question One: What is the mean difference between the interest of physics students exposed to virtual reality-based instruction and those taught using conventional teacher-centred method of teaching?

To answer research question one, the post-test scores of students for PIS in the experimental and control groups were subjected to descriptive statistics in form of Means and Standard Deviations. This is presented in Table 1

Table 1: Analysis of Post-Test Means and Standard Deviations Scores for PIS of the Experimental and Control Groups

Type of scores	Groups	N	Mean	SD	Std. Error	Mean Difference
Post- test for PIS	Experimental	52	45.21	4.141	0.574	7.08
	Control	64	38.13	4.284	0.594	

Table 1 revealed that the post-test means and standard deviations 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 in favour of the experimental group.

Research Question Two: What is the mean difference between male and female students' interest on physics when exposed to virtual reality-based instruction?

To answer research question four, the post-test scores of students for PIS in the experimental group for male and female students were subjected to descriptive statistics in form of Means and Standard Deviations. This is presented in Table 2

Table 2: Analysis of Post-Test Means and Standard Deviations Scores for PIS of the Experimental Group for Male Female students

Type of scores	Groups	N	Mean	SD	Std. Error	Mean Difference
Post- test for PIS (experimental	Male	18	45.05	4.472	0.682	0.95
	Female	34	46.00	1.871	0.624	

Table 2 revealed that, the post-test means and standard deviations for PIS of male students in the experimental Group were 45.05 and 4.472 and that of female students were 46.00 and 1.871. The post-test mean score difference was 0.95 in favour of the females.

Testing of Hypotheses

This section analyzed data using statistical tools to test the two (2) null hypotheses formulated for the study, using the inferential statistics of t-test Independent sample at 0.05 level of significance

Hypothesis One

Ho_1: There is no significant difference between the interest of physics students exposed to virtual reality-based instruction and those taught using teacher-centred method of teaching.

In order to test hypothesis five, the post-test scores in the experimental and the control 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 Post-Test Mean Scores for PIS of the Experimental and Control Groups

Groups	N	Mean	SD	Df	t-value	P-value	Decision
Experimental	52	45.21	4.141				
				115	8.565	0.000	Significant
Control	65	38.13	4.284				

Table 3 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 thus, this study rejected the null hypothesis one (1) that says there is no significant difference between the interest of physics students exposed to virtual reality-based instruction and those taught using teacher-centred method of teaching. The decision implies that, there is a significant difference in the mean score of interest in Physics between those exposed to virtual reality-based instruction and those taught using conventional teacher-based method of teaching. This indicates that the students of experimental group performed significantly better than those in control group in interest of physics, this is as result of virtual reality-based instruction.

Hypothesis Two

Ho2: There is no significant difference between male and female physics students' interest in Physics when exposed to virtual reality-based instruction.

In order to test hypothesis two (2) the pos-test scores of male and female students for PIS in the experimental group 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 Means Scores of Male and Female Students for PIS of the Experimental Groups

Groups	N	Mean	SD	Df	t-value	P-value	Decision
Male	18	45.05	4.472				
				50	.624	.535	Not sig.
Female	34	46.00	1.871				

Table 4 revealed that the t-value computed was 0.624 and the p-value of 0.535 was observed. Since the obtained p-value of 0.535 is greater than the alpha value of 0.05 thus, this study retained the null hypothesis two (2) that says there is no significant difference between male and female physics students' interest in Physics when exposed to virtual reality-based instruction. This indicates that the students of experimental group performed significantly better than those in control group in interest of physics, this is as result of virtual reality-based instruction.

Discussion of Findings

The finding of this research also, revealed that there is a significant difference in mean scores of interest in Physics between those exposed to virtual reality-based instruction and those taught using conventional teacher-based method of teaching. This implies that the use of virtual reality-based instructional strategy in teaching physics enhances students' interest in physics the study agreed with the findings of Sunday (2007) in his study on the effects of epodewalad and power Simulation Games on Students Achievement and Interest in some Environmental Education Concepts in Geography, his research findings shows that simulation games in teaching have significant influence on students' interest.

Moreover, the result of this finding shows that there was no significant difference in mean scores of interest in Physics between male and female students when exposed to virtual reality-based instruction. This implies that students exposed to virtual reality-based instruction relatively similar with no significant difference in mean scores interest. However, this study disagreed with findings of Hoffmann (2002) who revealed that girls find physics less and less interesting as they grow older; and, by the end of the 5th

grade, well before the majority of classes begin to study physics, girls generally show markedly less interest than boys in most of the areas of physics. According to him, girls generally regard physics as belonging to the group of the least interesting subjects; and, boys to those that are the most interesting.

Conclusion

Based on the findings of this research, the following conclusions were drawn:

1. Virtual reality-based instruction enhances the students' interest in Physics concepts among senior secondary school students under study.
2. Virtual reality-based instruction is a gender friendly instructional strategy with respect to the interest.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Science teachers should incorporate the use of virtual reality-based instruction to complement their traditional chalk-talk method of instructional to make students developed interest in physics and other science subjects.
2. Educational stakeholders should encouraged physics teachers to use virtual reality-based instruction in teaching the subject in order to improve the interest of both male and female students in the subject.

References

Abdulgaffoor, K. (2013). Differences in students' interest in physics by gender and stage of schooling in Kerala. *Indian Journal of Education*, *2*(39): 99-108

Ashok, V. (2005). The Male-Female Hologram," *Times of India*, pp 9

Bamidele, L. (2004). Students' poor performance in physics, a bane to our nation's technological development, *Nigerian Journal of Science Education and Practice*, *2*(1): 174

Bello, G. (2002). Gender difference in School Science: Implication for science teacher education. *Journal of Curriculum and Instruction*, *6*(1&2): 55-63

Chwen Jen, C. (2016). Theoretical bases for using virtual reality in education *Themes in Science and Technology Education.* pp. 71-90

Crosier, J., Cobb, S., & Wilson, J. (2000). Experimental comparison of virtual reality with traditional teaching methods for teaching radioactivity, *Education and Information Technologies, 5*(4):329-343, Kluwer Academic Publishers, Netherlands

Crosier, J., Cobb, S., & Wilson, J. (2000). Experimental comparison of virtual reality with traditional teaching methods for teaching radioactivity, *Education and Information Technologies, 5*(4):329-343, Kluwer Academic Publishers, Netherlands

Crouch, I. (2014). Effect of virtual reality on students' understanding on and interest of physics *(unpublished Masters Dissertation)* Michigan technological university

Eisenhart, M., & Finkel, E. (2000). Women's science: learning and succeeding from the margins: Science Education. (84th ed.) Chicago: University of Chicago Press. pp. 34–36.

Ghozali, I. (2001). *SPSS application of multivariate analysis*, (2nd ed.). Diponegoro University, Semarang, Indonesia,

Hidi, S., Renninger, A., & Krapp, A. (2004). Interest, a motivational variable that combines affective and cognitive functioning in D.Y. Dai & R.J. Sternberg (Eds.). *Motivation, emotion, and cognition.* (pp. 89-115). Mahwah, NJ: Lawrence Erlbaum.

Hoffman, L. (2002). Promoting girls' interest and achievement in physics classes for beginners .*Learning and Instruction, 12*: 447–465

Kola, A., & Taiwo, A. (2013). Analysis of Gender Performance in Physics in Colleges of Education, Nigeria, *Journal of Education and Practice 4*(6): 201-213

Krupp, E. (2003). *Echoes of the Ancient Skies: The Astronomy of Lost Civilizations*. Dover Publications. ISBN 978-0-486-42882-6.

Lyons, T. (2004). Choosing physical science courses: The importance of cultural and social capital in the enrolment decisions of high achieving students. *Paper presented at the XI IOSTE Symposium,* Lublin, Poland.

Mekonnen, S. (2014). Problems challenging the academic performance of physics students in higher governmental institutions in the case of Arbaminch, Wolayita Sodo, Hawassa and Dilla Universities, *Natural Science*, *6:,*362 -375.

Savage, C., McGrath, D., McIntryre, T., Wegener, M., & Williamson, M. (2000). Teaching Physics Using Virtual Reality, *Centre for Learning and Teaching in the Physical Sciences*

Smith, R. (2010). The long history of gaming in military training. *Simulation & Gaming. 41* (1), 6-19. doi:10.1177/1046878109334330. ISSN 1046-8781.

Sunday, O. (2007). Comparative effect of Epodewalad and power simulation games on students' achievement and interest in some environmental education concepts in Geography. *(Unpublished Ph.D Thesis)*, University of Nigeria, Nsukka.

Ukoh, E. (2012). Effect of interactive invention instructional strategy on NCE pre-service teacher's achievement in physics and acquisition of science process skills. *Journal of Innovative Research in Management and Humanities*, *3* (1): 122–131.