EFFECTIVENESS OF INTERACTIVE HYPERMEDIA INSTRUCTIONS WHEN USED ALONE AND WHEN COMBINED WITH LECTURE METHOD ON SECONDARY SCHOOL STUDENTS' ACHIEVEMENT AND INTEREST TOWARDS PHYSICS IN MINNA, NIGERIA

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Abstract *Students' poor performance in physics has been attributed to ineffective and uninteresting instructional strategies. This study was therefore carried out to examine the effectiveness of interactive hypermedia instructions when used alone and when combined with lecture method on secondary school physics students' achievement and interest in Minna, Nigeria. A pretest, posttest quazi-experimental design was employed. Two research questions were raised to guide the study and two hypotheses were tested. A total of 71 physics students selected from intact classes of three purposively selected co-educational secondary schools that were randomly assigned to Experimental Group I (exposed to hypermedia instruction only), Experimental Group II (exposed to hypermedia + lecture method) and Control Group (taught through lecture method only) were employed for this study. Physics Achievement Test (PAT) and Physics Interest Inventory (PII) were used for data collection. Both PAT and PII were validated by experts and reliability coefficients of 0.76 and 0.81 were respectively obtained using Kuder-Richardson (Kr-21) and Cronbach Alpha's formula. Data gathered were analyzed using Mean, Standard Deviation and Analysis of Covariance and significance was ascertained at 0.05 alpha level. Findings revealed that significant difference exists in the mean achievement ($F (2, 67) = 62.010$, $p < 0.05$) and interest ($F (2, 67) = 128.230$, $p < 0.05$) scores of students exposed to hypermedia instructions only, hypermedia with lecture method, and lecture method only. It was therefore recommended among others that hypermedia instructions should be used to supplement conventional lecture method of teaching to improve students' achievement and interest towards physics.*

Keywords: Hypermedia instructions, Achievement, Interest, Physics, Lecture method

Introduction

The focus of educational researchers all over the world today is to bring improvement into teaching and learning process. As such, various innovative strategies and methods have evolved to tackle the menace of students' poor performance especially in science-based subjects. One of such innovative strategy is the use of interactive hypermedia instructions which is the focus of this study. The rationale for carrying out the study, the methodology employed as well as findings and implications that emanated are presented in this article.

Academic and Psychological Efficacies of Hypermedia Instructions

The technological development of any nation lies in the study of science. Specifically, science is incomplete without physics which is a core and compulsory subject for all science students in Nigerian secondary schools. Physics has proven its benefits to mankind as almost every human activity and virtually every profession involves some elements of physics and the subject is a requirement for many specialized science and engineering courses in tertiary institutions (Falode, 2014, Javed, 2005).

Learning physics is a very complex cognitive task which requires a high level of commitment and effort on the part of the learner. Consequently students need to be motivated to cope with the learning of the subject. To cater for students' need in physics class, using interesting and stimulating instructional strategies become imperative. Hence, attention has shifted to the integration of Information and Communication Technology (ICT) driven learning processes. The rapid development of ICT hardware, software and telecommunication has increased the potential of technology in education of which computerbased instructions are integral parts (Batra, 2014).

One form of computer-based interactive learning environment is the hypermedia. It is an innovation which utilizes CD-ROM based programs and instructional contents delivered via the World Wide Web. Hypermedia materials are comprised of multiple nodes containing various media forms such as text, sound, graphics and movies either individually or combined (Batra, 2014). When a multimedia program is developed in a hypertext environment, the resulting product is called hypermedia (Udouudoh & Dahwa, 2015). The structure of a hypermedia system enables users to move from one node to another at will, accessing information from nodes that are more associative and are delivered in a non- linear sequence, allowing the learner greater control and interactivity (Handal & Herrington, 2003). Amadieu, Tricot and Marine (2008) added that hypermedia systems allow free exploration of non-linear information which is expected to satisfy the students' needs as they will be able to navigate and process information according their own needs. Learning from hypermedia implies learners performing tasks useful for learning and also navigation tasks which entails students' active participation in selection, control and regulation in information reading (Amadieu & Tricot, 2006).

Findings from earlier studies have revealed that interactive computer-based learning environments have positive effects on students' performance and also improve their interest towards learning of science subjects. Zywno and Waalen (2001) examined the effect of hypermedia on achievement and attitude of students with different learning styles. They found that hypermedia had positive effects on students' achievement. Similarly, Mustafa and Sharif (2011) developed an adaptive e-learning hypermedia system and their finding after its' utilization in learning process revealed that students taught using the hypermedia performed significantly better than students taught without it. Also, finding of a study on the effect of interactive hypermedia program on students' achievement in Mathematics conducted by Batra (2014) revealed that hypermedia program led to better achievement in Mathematics. However, Falode and Onasanya (2015) in their study on the teaching and learning efficacy of interactive virtual laboratory package on selected Nigerian secondary school physics concepts found that there was no significant difference between the achievement of students taught physics through physical laboratory and virtual laboratory as both strategies were effective and enhanced achievement in physics by secondary school students.

Apart from the fact that interactive computer-based learning environments bring about improvement in students' performance, such environments also help to foster students' interest towards learning contents. Interest is an excitement accompanied by special attention to carry out a task. Ogundola (2014) described it as a fundamental factor necessary for supporting effective learning because it is capable of arousing

students' curiosity. When students' curiosity are aroused, there would be desire to re-engage in learning activities, seek for more answers to questions, acquire more knowledge, understand better and invariably perform better in academic tasks. Students' interest in learning activities could be increased through the use of suitable teaching strategies and computer-based learning environments. Ogundola (2014) and Igoanugo (2013) in their studies found that suitable teaching strategies increased students' interest and eventually led to higher achievement. Similarly, Abd-El-Aziz and Jimoh (2015) found that students' interest was better stimulated and maintained through computer-based instruction.

Students' performance in secondary school physics examinations conducted by West African Examinations Council (WAEC) and National Examinations Council (NECO) has relatively been poor over the past few years. One of the major reasons attributed to such awful performance is the use of low stimulating and non captivating instructional strategies which prevent students from paying attention and also inhibit proper understanding of physics contents as well as poor skills in physics laboratory exercise (Aina, 2012; Falode & Onasanya, 2015). To cater for students' need in physics class therefore, using interesting and stimulating instructional strategies becomes imperative. One innovation that supports students' independent study and interactive engagement in learning process and that can enhance students' active involvement while learning physics is hypermedia instruction.

Despite the enormous benefits of hypermedia instructions in teaching and learning process and as buttressed by the findings of researchers that were cited in this work, who earlier found that hypermedia instructions improved students' achievement, no study was found to have been conducted on the effectiveness of hypermedia as it affects Nigerian secondary school physics students' achievement and interest towards learning physics. Hence, this study was carried out to determine the effectiveness of hypermedia instructions when used alone and when combined with lecture method on secondary school students' achievement and interest towards physics in Minna, Nigeria.

This study was carried out to determine whether researchers-developed hypermedia instruction would improve secondary school physics students' achievement and interest towards physics in Minna, Nigeria. Specifically, it sought to determine the differences in the:

i. achievement of students taught physics through hypermedia instruction only, hypermedia + lecture method, and lecture method only.

ii. interest of students taught physics through hypermedia instruction only, hypermedia + lecture method, and lecture method only.

The following questions were raised to guide the study:

1. What is the difference in the mean achievement scores of secondary school physics students exposed to physics through hypermedia instruction only, hypermedia + lecture method, and lecture method only?

2. What is the difference in the mean interest scores of secondary school physics students taught physics through hypermedia instruction only, hypermedia + lecture method, and lecture method only.

These two hypotheses were tested:

H_{O1}: There is no significant difference in the mean achievement scores of secondary school physics students taught physics through hypermedia instruction, hypermedia + lecture method, and lecture method only.

H_{O2}: There is no significant difference in the mean interest scores of secondary school physics students taught physics through hypermedia instruction, hypermedia + lecture method, and lecture method only.

The study adopted a pretest and posttest quazi-experimental design. Three levels of independent variables (two experimental and one control) were investigated on students' achievement and interest towards physics. The independent variables were the hypermedia instruction, lecture method of instruction and the combination of the two. Students' achievement in physics and their interest towards the subject as a result of the manipulation of the independent variables were the dependent variables of this study. The investigation involved the use of researchers' developed achievement test and inventory to elicit needed information from physics students. To determine the learning effectiveness of the hypermedia instructions, and its' combination with lecture method, physics achievement test was administered as pretest and posttest on secondary school students before and after being exposed to the strategies. Also, interest inventory was administered before and after exposure to determine students' interest towards physics.

The population of the study consisted all secondary school physics students in Minna, Niger State, Nigeria while the target population was made up of all senior secondary school class one ((SSI) physics students in the 2014/2015 academic session. Purposive sampling technique was employed to select three co-educational secondary schools because of their equivalence in terms of physics laboratories, computer laboratories, being public schools, having enrolled students in SSCE physics for a minimum of five years, availability of ICT staff, physics teachers and students' exposure to computer-based learning. The three schools were randomly assigned to Experimental Group I (exposed to hypermedia instruction only), Experimental Group II (exposed to hypermedia + lecture method) and Control Group (taught through lecture method only). A total of 71 SSI physics students were employed from three intact classes from the purposively selected schools.

Two research instruments: Physics Achievement Test (PAT) and Physics Interest Inventory (PII) were used for data collection. PAT was developed by the researchers and it was administered as pretest and posttest. It consists of 25 multiple-choice objective items on the three secondary school physics topics (measurement and unit, fundamental and derived units, and motion) treated. Each question was followed by five options (A-E) out of which students were required to select the correct answer. Every correct answer was awarded one mark while every wrongly answered question was scored zero. The cumulative score of each student in the test was converted to percentage. Similarly, PII was developed by the researchers and was segmented into two sections (Sections A & B). Section A was designed to collect demographic information of the respondents while Section B consists of 15 items on student's interest towards learning physics. It was designed using the 4-point scale (namely, 1 as Strongly Disagree, 2 as Disagree, 3 as Agree and 4 as Strongly Agree). The questionnaire was also administered to the students in the three groups as pretest and posttest. PAT was validated by four physics teachers while one Guidance psychology expert and two science education experts validated the PII.

Hypermedia website was developed using Hypertext Preprocessor; an HTML surrounded scripting language, JAVASCRIPT and CSS programming language. The website contains three well-structured and interactive senior secondary school class one (SSI) physics topics: measurement and unit, fundamental and derived units, and motion, and students would navigate through the site by clicking on multiple links that direct them to other links where text, sound, animations, video and pictorial files can be viewed and studied. Special attention was given to the organization of the physics contents and navigational techniques since it is the userfriendly organization that represents the essential idea behind hypermedia. Similarly, learner-content, learnerlearner and learner-teacher interactions enabled tools were embedded in the hypermedia site. The hypermedia website was developed by the researchers with the assistance of a programmer and web designer and it was validated by two computer experts, three physics teachers and two educational technology experts. Based on experts' suggestions, some links were re-directed, the background colour of the site was changed and typographical errors were removed.

A pilot study was conducted in a school within Minna but that was not selected for the main study. PAT and PII were administered once on 18 SSI physics' students and reliability coefficients of 0.76 and 0.81 were obtained for PAT and PII using Kuder-Richardson (Kr-21) and Cronbach Alpha formulas respectively. Hence, the instruments were considered appropriate for this study.

The researchers and two trained research assistants administered the research instruments to the students. The hypermedia website address was copied for the students and was able to learn physics online with the use of stand-alone computers that were connected to the internet in the computer laboratories of the schools used as Experimental Groups I and II. Students in Experimental Group I learnt physics through hypermedia website only, students in Experimental Group II were first exposed to lecture method before using the hypermedia website for supplementary instruction while students in the Control Group were taught the same physics topics by their teacher using lecture method only. PAT and PII were administered before and after the administration of treatments to the three groups as pretest and posttest and the administration of the treatments lasted for three weeks.

Data gathered from the administration of the research instruments were used to answer the research questions raised and also to test the two research hypotheses. Specifically, Mean, Standard Deviation and Analysis of Covariance (ANCOVA) were used and significant level was ascertained at 0.05 alpha level.

The results obtained from the data are presented as follows to answer and test the hypotheses:

HO_1: There is no significant difference in the mean achievement scores of secondary school physics students taught physics through hypermedia instruction only, hypermedia + lecture method, and lecture method only.

Table 1:

Mean and standard deviation of achievement scores of experimental group I, II and the control group at pretest and posttest

Group	N	Pretest		Posttest		Mean			Difference
		$\bar{X}$	SD	$\bar{X}$	SD				
Experimental I	25	21.36	6.55	60.20	8.81	38.84			
Experimental II	24	31.00	7.02	72.50	7.75	41.50			
Control	22	25.55	7.86	45.59	6.37	20.04			

Table 1 reveals the mean and standard deviation of achievement scores of students taught physics in Experimental Group I (Hypermedia only), Experimental Group II (Hypermedia + Lecture Method) and Control Group (Lecture Method only). From the Table, it was observed that the mean scores of the three groups at posttest differ where Experimental Group II had the highest mean scores of 72.50 with standard deviation of 7.75, followed by Experimental Group I which had mean scores of 60.20 with standard deviation of 8.81 while the Control Group had the least scores at posttest with mean scores of 45.59 and standard deviation of 6.37.

Table 2:

Summary of Analysis of Covariance (ANCOVA) of posttest achievement scores of experimental group I, II and the control group

Source	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	8527.418	3	2842.473	48.976	.000
Intercept	13454.106	1	13454.106	231.815	.000
Covariate (Pretest)	210.765	1	210.765	3.631	.061
Main Effect (Treatment)	7197.861	2	3598.931	62.010*	.000
Error	3888.553	67	58.038		
Total	266578.000	71			
Corrected Total	12415.972	70			

*: Significant at 0.05 level

Table 2 shows the ANCOVA result of the comparison of posttest achievement scores of students taught physics in Experimental Group I, II and the Control Group. An examination of the Table shows ($F(2, 67) = 62.010$, $p < 0.05$). On the basis of this, hypothesis one was rejected. Therefore, there was significant difference in the achievement of students taught physics in Experimental Group I (those taught through Hypermedia only), Experimental Group II (those taught through Hypermedia + Lecture method) and those

in Control Group (through lecture method only). Sidak post-hoc analysis was carried out to locate where significant difference exists as presented in Table 3.

Table 3:
Sidak post-hoc analysis of the posttest mean achievement scores of students in experimental group I, II and the control group

Treatment	Experimental I	Experimental II	Control
Exp. I (Hypermedia)		-9.92*	15.64*
Exp. II (Hypermedia+Lecture)	9.92*		25.56*
Control (Lecture)	-15.64*	-225.56*	

*: Significant at p= 0.05 level.

Table 3 shows the Sidak post-hoc analysis of posttest mean achievement scores of students in Experimental Group I, Experimental Group II and the Control Group. The table indicates that significant difference exist between the mean scores of students in Experimental Group I and Experimental Group II (mean difference = -9.92). It also shows that significant difference exist between Experimental Group I and the Control Group (mean difference = 15.64) and also between Experimental Group II and the Control Group (mean difference = 25.56).

The implication of the analyses presented in Table 1, 2 and 3 is that the combination of Hypermedia and Lecture method improves students' achievement in Physics better than the use of Hypermedia only or lecture method only, while Hypermedia only also improves students' achievement better than lecture method only.

H_{O2}: There is no significant difference in the mean interest scores of secondary school physics students taught physics through hypermedia instruction, hypermedia + lecture method, and lecture method only.

Table 4:
Mean and standard deviation of interest scores of experimental group I, II and the control group at pretest and posttest

Group	N	Pretest		Posttest		Mean			Difference
		$\bar{X}$	SD	$\bar{X}$	SD				
Experimental I	25	29.28	5.63	67.12	2.22	37.84			
Experimental II	24	26.79	3.24	59.96	6.13	33.17			
Control	22	22.50	5.71	40.09	6.21	17.59			

Table 4 reveals the mean and standard deviation of interest scores of students taught physics in Experimental Group I (Hypermedia only), Experimental Group II (Hypermedia + Lecture Method) and Control Group (Lecture Method only). From the Table, it was observed that the mean scores of the three groups at posttest differ where Experimental Group I had the highest mean scores of 67.12 with standard deviation of 2.22, followed by Experimental Group II which had mean scores of 59.96 with standard deviation of 6.13 while the Control Group had the least scores at posttest with mean scores of 40.09 with standard deviation of 6.21.

Table 5:

Summary of Analysis of Covariance (ANCOVA) of posttest interest scores of experimental group I, II and the control group

Source	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	9028.135	3	2842.473	48.976	.000
Intercept	7394.918	1	13454.106	231.815	.000
Covariate (Pretest)	0.002	1	0.002	0.000	.0992
Main Effect (Treatment)	6857.123	2	3428.562	128.230*	.000
Error	1791.414	67	26.738		
Total	236059.000	71			
Corrected Total	10819.549	70			

*: Significant at 0.05 level

Table 5 shows the ANCOVA result of the comparison of posttest interest scores of students taught physics in Experimental Group I, II and the Control Group. An examination of the Table shows ($F (2, 67) = 128.230$, $p < 0.05$). On the basis of this, hypothesis two was rejected. Therefore, there was significant difference in the interest score of students towards physics in Experimental Group I (those taught through Hypermedia only), Experimental Group II (those taught through Hypermedia + Lecture method) and those in Control Group (through lecture method only). Sidak post-hoc analysis was carried out to locate where significant difference exists as presented in Table 6.

Table 6:

Sidak post-hoc analysis of the posttest mean interest scores of students in experimental group I, II and the control group

Treatment	Experimental I	Experimental II	Control
Exp. I (Hypermedia)	-	7.17*	27.04*
Exp. II (Hypermedia + Lecture)	-7.17*		19.87*
Control (Lecture)	-27.04*	-19.87*	

*: Significant at p= 0.05 level.

Table 6 shows the Sidak post-hoc analysis of posttest mean interest scores of students in Experimental Group I, Experimental Group II and the Control Group. The table indicates that significant difference exist between the mean scores of students in Experimental Group I and Experimental Group II (mean difference =7.17). It also shows that significant difference exist between Experimental Group I and the Control Group (mean difference = 27.04) and also between Experimental Group II and the Control Group (mean difference = 19.87).

The implication of the analyses presented in Table 4, 5 and 6 is that the use of Hypermedia only improves students' interest towards physics better than Hypermedia + Lecture method while the use of Hypermedia + Lecture method also improves students' interest better than the use of lecture method only.

Discussion of Findings

Finding that emanated from this study indicated that the combination of Hypermedia instruction and Lecture method improves students' achievement in Physics better than the use of Hypermedia only or the use of lecture method only, while the use of Hypermedia only also improves students' achievement better than the use of lecture method only. The bottom line is that hypermedia improved students' achievement in physics. This finding is in agreement with the earlier findings of Zywno and Waalen (2001) who found that hypermedia had positive effects on students' achievement; Mustafa and Sharif (2011) who found that students taught using hypermedia instruction performed significantly better than students taught without it; and Batra (2014) who found that hypermedia program led to better achievement of students in Mathematics.

Since this study was able to establish the fact that students' achievement in physics was improved when hypermedia was involved (whether alone or when combined with lecture method), it could be said that the improved achievement of students in physics when lecture method was used alongside hypermedia was as a result of the physical presence and role played by the teacher in the learning process in terms of monitoring, providing guidance and ensuring that students' did not deviate from the learning tasks to concentrate on other less productive tasks on the internet.

Another finding that emanated from this study indicated that the use of Hypermedia instruction only improves students' interest towards physics better than the combination of hypermedia and lecture method while the latter also improves students' interest towards physics better than the use of lecture method only. This finding is in agreement with the earlier findings of Abd-El-Aziz and Jimoh (2015) who found that students' interest was better stimulated and maintained through computer-based instruction. This finding does not contradict the views of Ogundola (2014) and Igoanugo (2013) that suitable teaching strategies increased students' interest and lead to higher achievement. The improved interest of students towards physics when hypermedia instructions were used could be as a result of the involvement of computer as medium of instruction in the learning process since it is widely believed that generally, children have likeness for computer.

From the findings that emanated from this study, it can be concluded that Hypermedia instruction is effective in teaching and learning of physics. Its' usage to complement lecture method improved students' achievement in physics better than the use of it alone or the use of only lecture method. Similarly, the use of hypermedia helped secondary school students' develop interest towards physics. When students' interest towards physics improves, there is no doubt that their performance in the subject will also be improved.

Implications

The following recommendations are made based on the findings that emanated from this study:

1. Physics teachers should supplement the popular conventional lecture method of teaching physics with hypermedia instructions as their combination would improve students' achievement in the subject.

2. Physics students should be encouraged to explore the interactive learning opportunities presented by hypermedia site. This will enable them develop interest towards physics and subsequently achieve better in the subject.

3. Since students that were exposed to hypermedia instructions achieved better than their counterparts that were taught physics through lecture method only, in situations where the combination of both is not possible, the use of hypermedia site should be given preference in learning of secondary school physics.

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