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EFFECTS OF TWO SELECTED INTELLIGENT TUTORS ON PRE-SERVICE PHYSICS TEACHERS' ACADEMIC PERFORMANCE IN COLLEGES OF EDUCATION ON SOUTHWESTERN NIGERIA

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Abstract:
This study investigated the effects of the developed and adapted intelligent tutoring systems on academic performance of pre-service physics teachers in colleges of educations, southwestern Nigeria. It determines the effect of the intelligent tutors on retention of Physics concepts at the colleges of education. This is with the ultimate goal of proffering solution to the challenges of achieving some of the objectives of Physics education in the nation. The study adopted non-equivalent pretest - posttest control group design. The population comprised Physics students in colleges of education in Southwestern Nigeria. Three colleges of education were purposively selected from three states in Southwestern Nigeria based on proximity, willingness to participate in the experiment, availability of ICT facilities and a favourable academic calendar. Three intact classes of 200 Level Physics students who were randomly assigned to the locally developed intelligent tutoring systems labelled (ITPA), adapted intelligent tutoring systems labelled (ITPB) and the control groups were taught the topics Vector and Circular Motion. Intelligent Tutoring Performance Test (ITPT) an achievement test was used as pre and posttests for the academic performance. Data collected were analyzed using mean, t-test, one way Analysis of Variance (ANOVA), Scheffé and Bonferroni post-hoc analyses. The results showed significant difference in the posttest as well as in

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the retention test of those taught using the developed tutor, the adapted tutor and control ($F = 144.32$; $p < 0.05$).

Keywords: pre-service physics teachers, academic performance, the intelligent tutors

1. Introduction

Physics is perceived by parents and students as an elitist subject as detected in their attitude. They are of the opinion that the subject is mainly for brilliant students since there are lots of theories and laws to be memorized. These erroneous beliefs made Physics to be perceived as designed for highly intelligent and brilliant students (Adeyemo, 2010). Students who have indicated interest in Physics sometimes are turned down by the school counselors and administrators because of the perceived low intelligent quotient of the students concern. Students who showed interest in the subject had also been ill advised of the difficulty in performing very well academically in the subject; thus leading to students choosing perceived less abstract subjects at the expense of Physics which they consider is abstract.

The science and technology policy in Nigeria advocated for the ratio 60: 40 for Science and non-science courses for the conventional Universities, ratio 70: 30 for the universities of technology and ratio 80: 20 for the Polytechnics (Ige, 2013). Unfortunately an appraisal of Science: non science ratio in most of the schools in the southwest reveals that there are more non-science students than their science counterparts. In most secondary schools, only one arm of science class of about fifty students are in existence with about four arms for non-science students resulting to a ratio of more than 40:60 for science and non-science subjects. From the above poor implementation of the prescribed ratio, there is therefore the need to explore and experiment with different methodology of teaching in order to make this goal realizable.

The poor performance of students observed in the subject is traceable to the quality of teachers that are teaching the subject as well as the methodology employed in its teaching. Physics is the backbones of technological development of any nation; it is pertinent that students are encouraged in studying the subject. This can be achieved by ensuring that competent and qualitative Physics teachers that possess good mastery of the subject and that will be able to teach the subject effectively are produced. This will make the laudable goal of producing competent indigenous scientists and engineers right from the secondary schools achievable.

Reid and Skryabina (2002) opined that attitude enhances academic performance; therefore, poor attitude of the students to Physics subject may partly be responsible for their poor academic performance. Oteyola and Idowu (2014) posited that intelligent tutoring system aided students' attitude towards Physics. It is therefore presupposed that the use of intelligent tutor entrenched in the right pedagogy coupled with the interest of the students will help them to perform brilliantly in Physics. One way to ensure that teachers will adopt same after graduation is to expose them to similar methodology while in training. The poor academic performance in Physics has been witnessed is therefore traceable to poor methodology adopted in teaching which also made the students to develop fear for Physics right from home.

The lecture (chalk and talk) methods of teaching as found in the colleges of education and in tertiary institutions in Nigeria has been identified as one cogent factor affecting the realization of the goals of teacher education in the country (Udoh, 2012). This lapse adversely affects the quality of Physics teachers that are turned out from the colleges of education. As observed, graduates from colleges of education hardly have mastery of the subject matter of Physics, many of the pre-service teachers simply read to pass their various examinations while undergoing training in the school. This account for why it is not easy for them to integrate the use of technology into classroom instructions after graduation. They will rather employ the same obsolete and weak teacher-centred lecture method in teaching Physics at their various schools. The major reason teachers employed the talk and chalk method after graduation is traceable to the fact that they were not adequately exposed to the process of integration and application of information technology in instructional delivery while undergoing training at the various colleges of education. As a result of the low level of exposure, graduate teachers are found deficient in the utilization of the information and communication technology and were as a result unwilling to use the technology in the delivery of instruction in the later years (Yusuf, 2007).

Lecture method of teaching had been argued leads students to memorizing the results of other scientists instead of developing an inquisitive mind in them (Myer, 2006; Aladejana, 2006).Myer (2006) also argued that memorization decreases students' interest and motivation in a typical Physics class. It was further stated that teaching of science subjects should be inquiry and discovery based. As observed among students over the years, many of the students memorize the scientific theories and principles. They even go to the extent of memorizing calculations as well as solutions to class works just to pass examinations in Physics. They do pass the exams often time but with poor grade. This is as a result of teachers' adoption of lecture method in teaching Physics. Most of the students do not understand the underlining concepts and

principles of Physics. Several of them were found to forget the memorized facts almost immediately after writing examinations and therefore a number often could not reconcile what is been taught in the classroom with what occur in real life situations.

The poor method employed in the teaching of Physics negatively affected the attitude of the students to the subject. This consequently affects their academic performance in the subject. It appears impossible for teachers that had been taught using this lecture method to employ a method that they are not proficient in to teach the student. The lack of proficiency in the usage of the technology could be due to inadequate exposure of the teacher to the same technology in classroom instructions. Physics student-teachers do visit the internet to seek for solution to different assignments, but often times the student teachers are found wanting in effective use of the technologies and tools in instructional delivery. Consequently, the delivery of instruction to learners and resultant classroom management in the institutions of learning is negatively affected. The use of traditional (lecture) method in teaching as usual has been found to have limited the exposure of students to the use of information technology driven instructions. This is because teachers prefer the old talk and chalk method as a comfortable system of teaching to the use of information technology driven ones.

The revised National Policy on Education (FRN, 2004) section 11 subsection 102 p 53 explains the need for teachers' consistent exposure to innovations in order to be able to use new methodology to combat the curriculum that changes from time to time. For this reason, the teaching methods in use should also change so that the required technology that would improve teaching eventually becomes integrated in the teaching process. The most appropriate period for this laudable skill to be acquired by the teacher is when they are undergoing training in the various colleges or faculties of education at the university. This can be achieved by making the mode of instructing the student-teachers technology driven. Since the traditional methods are still adopted to teach; the new and modern methods may not be made acceptable and worthwhile to the student-teachers and hence the situation may become more precarious as ever. The talk and chalk method is not only obsolete but it is also weak for imparting knowledge to the students by the teachers.

Practicing teachers do not find acquisition of necessary skills for effective adoption of information technology easy to learn on the job despite their positive attitude towards its usage (Yoloye, 1990; Yusuf, 1998; Jegede and Owolabi, 2003; Yusuf, 2005). The average human being will always resist change unless forced to do so even when the change is inevitable Rogers (1995). Workshop and on the job trainings for the teachers had not yielded the essential and acquisition of the basic information

technology skills that the teachers need. Therefore, there is the need to integrate the use of appropriate information technology driven instructional method in the teaching of the student-teachers so as to familiarize them with effective use of information technology in instructional design.

Intelligent tutoring system is an aspect of artificial intelligence in which computer is made to perform as a tutor. Broadly defined in Association for the Advancement of Artificial Intelligence (AAAI) (2011), intelligent tutoring systems are educational software containing an artificial intelligent component. The software tracks students' work, tailors feedback and provide hints about the learning activity of the student. The software can make inferences about the strengths and weaknesses of the students and suggests remedial, enrichment and relevant additional work. The intelligent tutoring system (ITS) is also referred to as intelligent computer assisted instruction (ICAI). However, the essence of intelligent tutoring systems is to assist in providing individualized instruction which the conventional lecture method of teaching cannot provide. Real life situation can be simulated in the classroom using intelligent tutoring systems such that learners can through imagination experience a real life problem and provide possible solutions to the problem. Intelligent tutoring systems, an aspect of artificial intelligence in which computer is programmed to act as a tutor, is one of those forms of new technologies that have been found appropriate in enhancing learning gains and improved retention in introductory Physics (Oteyola, 2010). The knowledge of Physics and its application in technology is expected to lift Nigeria to greater heights as witnessed in some developed countries of the world like it is found in the United States of America, Brazil, in Russia, India and in China (BRIC countries) and former Union of Soviet Socialist Republics (USSR).

National Policy Brief Nigeria (2005) raises two cogent points concerning training of teachers and the new professional roles: (i) Training of student teachers in the area of ICT so as to improve learning by pupils (self-learning capacities in the students can be fully utilized through ICT); and, (ii) Development of teamwork through a cluster teaching method could enhance outreach to numerous schools in the local areas. Teachers that are well equipped with required skills in information technologies are expected to be more effective in quality knowledge impartation to learners of different ability group. It could be observed that up till now that the student-teachers in Nigeria generally and particularly those with background in Physics are not adequately exposed to the use of information technology (Omosewo 2007). Therefore the use of intelligent tutoring packages will aid student-teachers' exposure to the process of integrating technology that is information technology based into the classrooms instructions.

2. Statement of the Problem

Inadequate competent and qualitative Physics teachers and poor methodology of teaching Physics had been identified as factors that lead to poor academic performance of students in the subject. Intelligent Tutoring System (ITS), an aspect of artificial intelligence (AI) that was developed using constructivist framework, has been successfully used to address this challenge in advanced countries. Pre-service teachers in Nigeria are not familiar with it in spite its usefulness. There is the need to test the effectiveness of both the adapted constructivist based intelligent tutor and the locally developed linking theory based which combines behaviourism, cognitivism and constructivism intelligent tutor.

2.1 Objectives of the Study

The objectives of the study are to:

(a) determine the effects of the two packages on students' academic performance in Physics in the colleges of education;
(b) determine the effects of the two packages on students' retention of Physics concepts in the colleges of education.

2.2 Research Questions

The research sought to provide answers to the following questions:

1. what is the effect of the two packages on students' academic performance in the colleges of education?
2. what is the effect of the two packages on retention of Physics concepts in the colleges of education?

2.3 Research Hypotheses

The following hypotheses were formulated:

1. there will be no significant difference in the posttest scores of students taught using the adapted package (ITPB) and the developed (ITPA) package.
2. there will be no significant difference in the posttest and retention test scores of the students that were taught using the developed package (ITPA).
3. there will be no significant difference in the posttest and retention test scores of the students that were taught using the adapted package (ITPB).

3. Methodology

3.1 Research Design

The study employed the pretest posttest nonequivalent control group design. The sample was categorized into one control and two experimental groups. Participants in experimental group A were taught using the locally developed intelligent tutor labelled ITPA while those in experimental group B were exposed to the adapted tutor labelled ITPB. Those in control group were taught using the teacher expository method (no treatment).

3.2 Population

The population for the study comprised all the Part II Physics students of colleges of education, in southwestern Nigeria.

3.3 Sample Selection

The sample for the study comprised an intact class of 99 NCE II Physics students from the purposively selected colleges of education. Thirty one of the students from Federal College of Education (Technical), Akoka, Lagos were taught using ITPA, 38 from Adeyemi College of Education, Ondo were exposed to ITPB while 30 from Osun State College of Education, Ilesa were in the control group. One college of education was purposively selected from three states in the southwestern Nigeria. The three colleges of education were purposively selected based on favourable school calendar for the research, the colleges were just resuming for new semester at the commencement of the study therefore there was adequate time to carry out the research. Availability and accessibility to facilities was another factor considered. The colleges were also selected as a result of the cooperation received from both the lecturers and the students. The lecturers in the selected colleges served as the research assistants for the study.

3.4 Instruments

The instrument used for the study was Intelligent Tutoring Performance Test (ITPT). This was a standardized 5-item essay questions extracted from Andes Physics Tutor question bank. Andes Physics Tutor is an Intelligent Tutor designed by Carnegie Melon University (CMU) and Pittsburgh Institute of Technology (PIT) both in the United States of America (USA) for teaching Introductory Physics. Each of the items has a score of 20 marks which sum up to 100 marks. Physics lecturers at Adeyemi College of Education, Ondo endorsed the suitability of the instrument for the study.

3.5 Instructional Packages

Two different forms of intelligent tutor were used in the study. They were locally developed intelligent tutor labelled ITPA and adapted constructivist-based existing intelligent tutor (Andes Physics Tutor) labelled ITPB. ITPA was locally developed using the linking theory as proposed by Rasch and Tennyson (1990) while necessary modifications was done to the existing constructivism-based Andes Physics tutor labelled ITPB so as to ensure its suitability for the research. These were the two instructional packages that were used to deliver the learning instructions to the students.

3.6 ITPA

The intelligent tutor labelled ITPA was developed using Visual Basic (VB6) software. The linking theory of learning promulgated by Rasch and Tenysson (1990) was adopted in the design. The behavioural objectives which highlighted what the students were expecting to learn by the end of the study were clearly stated. The students were required to click on the next button to navigate to the next page. At the next page multiple choice questions were asked to ensure that the students acquaint themselves with the objectives of the study. Correct responses that showed that the students concentrate on the study allowed the students to proceed to the next page. At the preceding page, circular motion and vector were defined. The educational goal at this stage was acquisition of declarative knowledge. Therefore, terms were defined and basic constructs in the topic being treated were explained. The students were required to click on next after they had mastered the page. Series of multiple choice questions were presented at the next page. The students were required to answer all the questions correctly before they can proceed to the next page. Inability of the students to get any of the questions correctly would return the students to the page where the terms were defined and the concepts explained. Successful completion of section I allows the students to navigate to section II. In the section, mathematical formulae that were related to the topics were explained and derived. The mathematical relationships between the explained construct in section I were equally derived and explained. The students were required to study the section II critically. Clicking on the next button leads to another multiple choice questions page which contains more complex questions than the previous page, thus lesson presentation was from simple to complex.

The questions then test the understanding of the formulae and explanation of the constructs and concepts. The students like in the previous multiple choice question pages were expected to answer all the questions correctly before they can proceed to the next page. Clicking on the next button on the page allowed the student to navigate to

the preceding page only if all the answers to the questions were correct. If not the students were directed to the beginning of the page. At the next page, the students were required to watch a problem-solving simulated video. The video explained into details how to solve mathematical problems involving the concept of circular motion. The students after watching the video were required to click on next button before they were led to solve three more complex questions. These questions were not multiple choice questions and the students were required to type the correct answer in the box provided. Digital clocks were built at this section of the systems. These clocks were to record the time spent on task at each level of the section. A wrong answer will direct the students to the beginning of the process while correct answer navigated the students to another more complex question. Reinforcement such as "clap for yourself", "you can be the best", "you cannot afford to lose concentration" were built into every of the stages as students navigate through the system. The students were able to type and print their names in gold after successful completion of the whole exercise. Two or more students can use the package interchangeably and therefore the whole process can turn to be a computer game while still learning. Thus, learning was made to be fun.

3.7 ITPB

The ITPB was adapted from the existing Andes Physics tutor. Andes Physics tutor was developed by Massachusetts Institute of Technology (MIT) at the University of Pittsburgh and United State Naval Academy both in U.S.A. Necessary modifications were made to the package for student use locally. The choice of Andes Physics tutor was necessitated because of its effectiveness. Its goal is to teach basic Physics problem solving techniques using concepts expressed in terms of symbolic variables, diagrams with drawn bodies, coordinates and vectors, correct international standard of units (S.I. units) and clear complete solutions. Its general features are immediate feedback (Green for correct step / Red for wrong step), "What's wrong?" and "Next step?" Help, Solver, Saved solutions and solution print outs, 0 – 100 qualitative grade on each problem and a timer (VanLehn, Lynch, Schulze, Shapiro, Shelby et al 2005). The Andes Physics tutor work bench is an interactive, self-discovery page. The intelligent tutor acts as a guide or a coach by making the students to construct learning from experiences. It is a problem solving intelligent tutoring system which teaches Physics by solving an example using real life experience. Through this process, the underlying concept of the topic been taught in Physics is analyzed. It thereafter provides a similar question to be solved by the learner and in the process, guide the learner to the correct answer. Hints are provided as the learner gets along with the problem. The learner is graded and the

duration of executing the task is also recorded as each step is taken to arrive at the answer.

The package labelled ITPB was adapted from the existing constructivist-based Andes Physics tutor. The choice of Andes physics tutor was based on its acceptance and usage by the American Naval School and also its adoption by Carnegie Mellon University in teaching introductory Physics to on-line students through her open learning initiative. The intelligent tutor is internet driven but due to high cost of internet connectivity, a standalone version of the tutor was adapted. Since local students are not familiar with the intelligent tutor the researcher, adapt the tutor by modifying some of the problem to be solved so that it can be made appealing and understandable to local students. The accent of the tutor which was American was modified to local accent using U-lead X5 video editing software.

4. Result and Discussion

A. What is the effect of the two packages on students' academic performance in the colleges of education?

Table 1: Pretest Mean Scores and Standard Deviation of Students Exposed to ITPA, ITPB and Control

S/N	Groups	N	Mean	S.D.
1	ITPA	31	4.94	1.48
2	ITPB	38	4.50	1.13
3	CONTROL	30	5.27	0.98

Table 2: Posttest Mean Scores and Standard Deviation of Students Exposed to ITPA, ITPB and Control

S/N	Groups	N	Mean	S.D.
1	ITPA	31	76.58	4.86
2	ITPB	38	80.55	5.27
3	CONTROL	30	69.93	5.21

Table 1 and table 2 show the effect of the two packages on academic performance of the students. The students that were taught using the developed package had a mean score of 4.94 and standard deviation of 1.48, those exposed to ITPB had a mean score of 4.5 and standard deviation of 1.13 while those taught using the lecture method had a mean score of 5.27 and standard deviation of 0.98 at the pretest. The students that were not exposed to any of the packages had a mean score of 69.93 and standard deviation of

5.21; those taught using ITPA the developed package had a mean score of 76.58 and standard deviation of 4.86 while those exposed to ITPB had a mean score of 80.55 and standard deviation of 5.27 at the posttest. There were considerable gains in learning for all the groups irrespective of the mode employed in teaching them. Those exposed to the adapted package had the most learning gain with mean equals 76.05; those that were taught using the developed package had learning gain of mean equal 71.64 while those in the control group had learning gain of mean equal 64.66.

The locally developed and the adapted packages enhanced academic performance of students in Physics.

B. What is the effect of the packages on retention of Physics concepts in the colleges of education in the region?

Table 3: Mean Scores of the Retention test and Standard Deviation of Students Exposed to ITPA, ITPB and Control

S/N	Groups	N	Mean	S.D.
1	ITPA	31	83.98	5.58
2	ITPB	38	82.50	6.33
3	CONTROL	30	67.63	6.47

The students that were exposed to ITPA have a mean retention test score of 83.98 and standard deviation of 5.58 while those students that were exposed to ITPB have a mean retention test score of 82.50 and standard deviation 6.33 as shown in Table 10. The mean retention test score for those in control group was 67.63 and standard deviation 6.47. Those that were taught using the developed package retain what was learnt better than those that were exposed to the adapted package. The two experimental groups had better retention than those in the control group. Intelligent tutoring packages aided students' retention of Physics concepts.

Hypothesis 1

There will be no significant difference in the posttest scores of students taught using the adapted package (ITPB) and the developed (ITPA) package.

Table 4: Analysis of Variance of Post-test Mean Scores of Students Exposed to ITPA, ITPB and Control Group

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	87.07	2	43.54	36.15	< 0.05
Within Groups	911.84	96	9.50		
Total	998.91	98			

Table 5: Post Hoc Test of the Comparism of the Post-test Mean Scores of Students Exposed to ITPA, ITPB and the Control Group

	(I) ITP Group	(J) ITP Group	Mean Difference (I-J)	Sig
Scheffe	ITPA	ITPB	1.12	0.33
		Control	-1.16	0.34
	ITPB	ITPA	-1.12	0.33
		Control	-2.28*	0.01
	Control	ITPA	1.16	0.34
		ITPB	2.28*	0.01
Bonferroni	ITPA	ITPB	1.12	0.41
		Control	-1.16	0.44
	ITPB	ITPA	-1.12	0.41
		Control	-2.28*	.010
	Control	ITPA	1.16	.436
		ITPB	2.28*	.010

*The mean different is significant at 0.05

Table 6: Calculated t-test of the Posttest Mean Scores of Students Exposed to ITPA and ITPB

Group	N	Mean	S.D	t	df	Sig
Posttest Scores of ITPA	31	76.58	4.86	-3.22	67	< 0.05
Posttest Scores of ITPB	38	80.55	5.27			

The hypothesis was tested by subjecting the scores into one way analysis of variance (ANOVA) as shown in table 4 and 5. The analysis revealed that there was significant difference in the posttest mean scores of students exposed to ITPA, ITPB and the control group $F_{2,96} = 36.15$; $p < 0.05$. The post hoc test using Scheffé and Bonferonnias shown in table 5 revealed that there was no significant difference in the posttest mean scores of those that were exposed to ITPA and the control group $p = 0.44$. There was no significant difference in the posttest mean scores of students that use the ITPA and those that were exposed to ITPB $p = 0.41$ but there was significant difference in the posttest mean scores of students that used the ITPB and the control group $p = 0.01$ at 95% level of significant. Subjecting the post-test mean score of students exposed to ITPA and that of ITPB to student t-test as shown in table6 revealed a significant difference in the academic performance of students that use the different packages $p = 0.00$.

The posttest mean score of those taught using the developed package was 76.58 while those taught using the adapted package had a posttest mean score of 80.55. p =

0.00 when the means were subjected to t-test. Since $p < 0.05$, the hypotheses which states that there will be no significant difference in the posttest scores of students taught using the developed package and those taught using the adapted package is therefore is not accepted.

Hypothesis 2

There will be no significant difference in the posttest and retention test scores of the students that were taught using the developed package (ITPA).

Table 7: Calculated t-test of the Mean Posttest Score and Mean Retention Test Score of Students that were Taught Using the Locally Developed Package

Group	N	Mean	S.D	t	df	Sig
Posttest Score ITPA	31	76.58	4.86	-6.42	30	< 0.05
Retention test Score ITPA	31	83.98	5.58			

As shown in table 7, the posttest mean score of the students taught using the locally developed package was 76.58 while their retention test means score was 83.98. Subjecting the scores to t-test analysis to determine if there is significance difference in the posttest mean scores and the retention test mean score of students that were taught using ITPA showed a significance difference with $p = 0.00$. Therefore, the hypothesis which states that there will be no significance difference in the posttest mean score and the retention test mean scores of the students that were taught using the developed package was rejected.

Hypothesis 3

There will be no significant difference in the posttest and retention test scores of the students that were taught using the adapted package (ITPB).

Table 8: Calculated t-test of the Mean Posttest Score and Mean Retention Test Score of Students that were exposed to the Adapted Package

Group	N	Mean	S.D	t	df	Sig
Posttest Score ITPB	38	80.55	5.27	-2.17	37	< 0.05
Retention test Score ITPB	38	82.50	6.33			

Table 9: Calculated t-test of the Mean Posttest Score and Mean Retention Test Score of the control

Group	N	Mean	S.D	t	df	Sig
Posttest Score Control	30	69.93	5.21	1.93	29	> 0.05

Retention test Score Control	30	67.63	6.47			

The posttest mean score of the students that were exposed to the adapted package was 80.55 while that of the retention test was 82.50. Subjecting the result to t-test analysis revealed that there was no significant difference with p = 0.04. Therefore, the hypothesis which stated that there will be no significant difference in the posttest scores and the retention test scores of students exposed to the adapted package was accepted.

There was significant difference in the mean posttest scores and the mean retention test score of the control group with p = 0.06 at 95% level of significant. While students that were exposed to both ITPA and ITPB have higher mean score in the retention test than the corresponding mean posttest scores those in the control group have lower mean score in the retention test than in the posttest.

Table 10: Calculated t-test of the Mean Posttest Score and Mean Retention Test Score of Students that were Taught Using the Developed Package, those that were Exposed to the Adapted Package and Control

Group	N	Mean	S.D	t	df	Sig
Posttest Score ITPA	31	76.58	4.86	-6.42	30	< 0.05
Retention test Score ITPA	31	83.98	5.58			
Posttest Score ITPB	38	80.55	5.27	-2.17	37	< 0.05
Retention test Score ITPB	38	82.50	6.33			
Posttest Scores Control	30	69.93	5.21	1.93	29	> 0.05
Retention test Scores Control	30	67.63	6.47			

The students that were exposed to ITPA have a mean retention test score of 83.98 and standard deviation of 5.58 while those students that were exposed to ITPB have a mean retention test score of 82.50 and standard deviation 6.33. The mean retention test score for those in control group was 67.63 and standard deviation 6.47. Subjecting the scores to t-test analysis to determine if there is significance difference in the mean posttest scores and the mean retention test score of students that were taught using ITPA shows a significance difference with p = 0.00. The same is observed with the students that were exposed to ITPB with p = 0.04. There was no significant difference in the mean posttest scores and the mean retention test score of the control group with p = 0.06 at 95% level of significant. While students that were exposed to both ITPA and ITPB had higher mean score in the retention test than the corresponding mean posttest scores, those in the control group had higher mean score in the posttest than in the retention test.

4.1 Effects of the Developed and the Adapted Intelligent Tutoring Package on Academic Performance

The locally developed as well as the adapted packages increase learning gain of the students in Physics. Students that were taught using the ITPA and those exposed to ITPB had better posttest scores than those that were not exposed to any of the treatments. The packages allow self-regulated learning. The students were able to learn at their own rate. There was no restriction to what and when to learn therefore they have better posttest scores than those in the control groups. This is in consonant with Aiyelaagbe (1998). Interacting with both the developed and the adapted packages was like playing computer game. Since game is always fun, then learning is made enjoyable and this also account for the reason in the achievement in the posttest scores. This also confirms the submission of Erdemir (2009). Those students that were exposed to the adapted tutoring package performed better than those that were taught using the developed package. The adapted package had more intelligence build in than the developed package. This agreed with Mark and Greer (1995), Shutte, Gawlick, Young and Bunhan (1996). It was expected that the developed package which was considered better designed should produce better academic gain but it was not so. Several factors like the effect of the packages on attitude to Physics could have been a reason for this because Kaya and Buyuk (2012) posited that attitude enhances academic performance rather than academic performance enhancing attitude. This is in concord with Normah and Salleh (2006).

4.2 Effects of the Developed and the Adapted Packages on Retention of Physics Concept

Those that were exposed to the packages had higher retention test scores than their posttest scores. The sequential mode of presenting the facts in the locally developed package would have accounted for the students remembering of the statements unlike in the adapted package where students were required to think through the solutions to the problems (Thalheimer 2010). The tendency that the packages endeared the students to learning suggested the reason for the students not wanting to leave the packages even when they were not being monitored. This would have accounted for the higher scores observed in the retention test scores. A drop in scores was observed in the retention test scores of students in the control group. This is traceable to the fact that memory decay over time as stated in the decay theory (h2g2 2006). The students that were taught using the developed package had more gain in retention of the concept than those exposed to the adapted package. Lesson presentation in the locally

developed package had more contextual cue that aided remembering built into it than the adapted package. These cues serve as motivators and they would have stimulated the students in wanting to interact with the locally developed package (Thalheimer, 2010). In all, there was significant difference in the retention scores of those that were exposed to the packages and their corresponding posttest scores. The two packages affect students' retention of Physics concept positively. Well-designed instructional packages had tendencies of enhancing students' retention of Physics concept (Shutte, 1995; Yusuf, 2007). Those that used the developed package were made to go through the same page several times until they have the mastery of what was in the page before they can proceed to the next level unlike those that were exposed to the adapted package. The repetitiveness of the task will in no small measure would have help in printing the concepts into the long term memory of the students unlike the effect the adapted package would have (h2g2, 2006). The quest to print the name in gold will equally be a short of fun to the students and this will also make them to navigate through the locally developed package as many times as possible and thus enhances repetition of the whole exercise severally.

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