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EFFECTS OF E-PORTFOLIO AND COMPUTER ASSISTED INSTRUCTIONAL PACKAGE ON STUDENTS' ACHIEVEMENT IN COMPUTER SCIENCE

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Abstract

Computer science at the senior secondary school level is taught to expose students to concepts that would aid learning. Several studies showed that in most of the secondary schools, there had not been enough qualified computer science teachers to handle the teaching of the subject.The study investigated the effects of e-Portfolio and Computer Assisted Instructional Package (CAIP) on students' academic achievement in Computer Science in Ondo State, Nigeria. The study adopted a pre-test, posttest, control group quasi-experimental research design. The sample for the study was 60 senior secondary school class two (SS2) students. A multistage sampling was adopted to select 20 students each from three purposively selected senior secondary schools as well as from some selected urban centre. Subjects in School A and B served as experimental groups, while subjects in School C served as control group. E-Portfolio served as treatment for group A; CAIP served as treatment for group B while conventional method of teaching was employed for the control group. The research instrument was Computer Science Achievement Test (COMSAT) (r=0.75). Data collected were analysed using mean and Standard Deviation.Tworesearch questions were raised and two hypotheses were tested at 0.05 level of significance.The study showed that students in e-Portfolio group performed better ($\bar{x}$=18.20) than students in CAIP ($\bar{x}$=14.60) and Conventional Method of Teaching (CMT) ($\bar{x}$=12.30) groups. Based on the findings, it was concluded that e-Portfolio package is more effective in teaching and learning of computer science than CAIP. It was therefore recommended that teachers should be encouraged to use e-Portfolio in teaching process.

Keywords:

E-Portfolio, computer assisted instructional package, achievement.

Introduction

Computer Studies as a subject was offered from Junior Secondary School one (JSSI) to three (JSSIII) and terminates at the Junior School Certificate Examination level. Students offering it as a subject at the Senior Secondary School level before the introduction in 2014, only attend classes in order to know more about computer studies but not for examination purposes except for the normal school examinations written in each school to test the performances of the students. The subject was introduced by the West African Examinations Council (WAEC) alongside 38 new subjects in its examinations in 2014 (Nigeria Bullettin, 2014).

There are several reasons for teaching or learning Computer science in secondary schools which include among others; ability to equip students for future technological awareness and basic computer skills; ability to use and improve on new technology so as to enhance the existing curriculum; and ability to promote change in education by moving towards a more relevant curriculum, the New Generation of Science Curriculum, NGSC NAST, (2016) and new definition of teacher's role (Isijola, 2018).

Computer is an electronic automatic machine which is capable of receiving, storing, recalling or retrieving information given in it (James, 2000). It is the fastest processing machine ever invented by man. Computer is useful in almost all spheres of life. It is very useful in most organizations particularly in hospitals for keeping records of staff, drugs, patients, used to diagnose diseases, conduct x-ray, monitor patient recovering pattern and accounts.

Virtually all daily activities can be computerised. This is one of the major reasons why Computer science as a subject is very important right from the elementary school level through junior and senior secondary schools, to the higher institutions. It is important for young and old in order to function effectively in digital age and be able to cope with any computer challenges that may arise.

With the introduction of writing the examination at the WAEC level, new curriculum for computer studies was developed by the Federal Ministry of Education which has to be implemented in order to cover the syllabus so as to make good grade at examinations level. The implementation of the new Secondary School Certificate Examination (SSCE) curricula began in September 2011, which means that the maiden public examinations based on the new/revised curricula was held in May/June 2014 (Nigeria Bulletin, 2014).

This led the researcher to compute the results from year 2019 to 2023 from five coeducational secondary schools in Ondo town situated in Ondo West Local Government Area of Ondo State result indicated that there were inadequate and unqualified teachers attached to the teaching the subject which is probably a pointer to the low performance of the students as presented below:

Year	No. of Schools	No. Reg. for WAEC	No. Reg- for Comp. Exam	No. Released	Students Performance based on Grades				
					A1-B3	C4- C6	D7 – E8	F9	Abs
2019		737	149	142	-	13 (9.1)	113 (79.6)	16 (11.3)	-
2020		670	98	97	1 (1.0)	24 (24.7)	68 (70.1)	4 (4.1)	1
2021	5	695	119	115	-	32 (27.8)	72 (62.6)	11 (9.6)	4
2022		775	180	175	1	44 (25.1)	115 (65.7)	15 (8.6)	5
2023		773	179	177	-	56 (31.6)	108 (61.0)	13 (7.4)	2

***Source*: Field survey, 2023**

It could be seen that for years 2020 and 2021, there was a particular school where two hundred and thirty (230) students were enrolled for West African Examination Council (WAEC) but none registered for the computer science examination simply because there were no teachers to handle the teaching of the subject. Also in year 2021, one of the schools surveyed registered one hundred and sixty eight (168) students for WAEC and none registered for the examination for the same reason. There was no teacher to handle the subject.

In other to achieve the effective teaching and learning of the subject, there is the need to employ qualified computer science teachers or in the absence of qualified teachers, organise orientation and training workshop for other subject teachers who are majorly the trainers. There is also the need to check the methods of teaching employed by the teacher to see whether they would enhance or impede the effective learning of the subject.

Computer studies in Senior Secondary Schools. In the alternative, where there are no teachers, an e-learning class could be arranged as a compromise and alternative in primary and secondary schools in Nigeria, most especially in Ondo State where there were not enough teachers. This situation informed the decision of the researcher to study and see how the situation could be ameliorated particularly in Ondo State, the state of origin.

E-learning is a method for delivering instruction, mainly at the university level, where students do not necessarily need to come within the four walls of the classroom or being physically present in the class for learning to take place. Coincidentally, with the COVID-19 pandemic presently ravaging the entire world resulting in lockdowns and closure of schools many nations including Nigeria, have necessitated the extension of e-learning to primary and secondary schools. This has laid credence to the much advocated principle of "deschooling the school". Enthusiasm for e-learning developed rapidly with the emergence of the internet and the development of the web.

The deployment of e-learning is becoming an important issue in current learning and teaching methodology. E-learning encompasses a wide range of applications and processes which make use of

available electronic media to deliver instruction.It covers computer-based learning, web-based learning, and the use of mobile technologies,it also includes virtual classrooms, computer interactivity on 3D environments and digital collaboration (Oloruntegbe&Gazi, 2010;Hafizan, 2015). E-learning has increasingly been used in most parts of the world as a viable alternative to conventional teaching.

It is a common knowledge that computer technology has revolutionalised human activities in the same way that e-learning has done for science education and education generally. For example, Bhuasiri, Xaymoungkhoun, &Ciganek (2012) observed that e-learning as a current medium of instruction through electronic means promotes students' knowledge and skills and also leads to improvement in their academic performance. They further submitted that e-learning brings about a far reaching paradigm change in the old system of teaching and learning which was more teacher-dominated but now gives room for learners to actively participate in the process – in a learner-centred approach.

Many types of e-learning had been created with advanced development tools, which are suited to the needs of the modern workplace learners. There are various types of e-learning solutions that can be employed to train the learners. Teachers only need to choose the type that best suits the needs of the learners, keeping in mind the available technologies that would help them access e-learning methods. According to Soni-Amitz (2017) e-learning methods are either synchronous or asynchronous in nature. Synchronous events take place in real time and this type of communication requires two people to be present at a given time. Examples of synchronous learning are group chat, video and audio conference, live webcasting, application sharing, whiteboard, polling, and virtual classrooms.

Asynchronous events are time-independent. A self-paced course is an example of asynchronous learning because online learning takes place at any time. E-mail or discussion fora are examples of asynchronous communication tools. In such cases, students ideally complete the course at their own pace, by using a Learning Platform like the Learning Management System (LMS). Examples of Asynchronous Learning are Self-paced – Shareable Content Object Reference Model (SCORM) a collection of standards and specifications for web-based electronic educational technology which defines communications between client side content and a host system. This is commonly supported by a learning management system, Audio/Video, E-mail, Discussion forum, Wiki/Blog, Webcasting/Conferencing, Computer-Based Training (CBT), Web-Based Training (WBT), Simulations on 3D environments and Game-based learning. E-portfolios are recent innovation and addition to those mentioned above. They are currently in use in some developed countries but not yet in the undeveloped ones. They can be used in educational institutions or in the economic or technical fields, and they have affected many features of the educational process (Ismail, 2005). Being a recent innovation with great potential, the researcher was prompted to undertake a study on its deployment in schools in Ondo State.

There are numerous ways in which the e-Portfolio can support teaching and learning process, including, but not limited to, assessing student performance, facilitating student reflection and displaying student achievement (Penny Light, Chen & Ittelson, 2012; O'Kesfee& Donnelly, 2013). Well-developed e-Portfolios have the potential to enable students to share their projects, documents and reflections from coursework spanning their entire programme, with clear programme – related criteria, in a collaborative virtual environment (Bryant &Chittum, 2013).

Lorenzo & Ittelson, (2005) opined that electronic portfolios have become a popular alternative to paper-based portfolios because they provide the opportunity to review, communicate and give feedback in an asynchronous manner. In addition, students are able to reflect on their work, which

makes the experience of creating the e-portfolio meaningful. A student e-Portfolio may be shared with a prospective employer or used to record the achievement of program or course specific learning outcomes. The profiling system seems to have benefited from e-portfolio. Widely used by US Department of Education and Science and many British organizations, profiling is a panaromic representations, numerical, graphical and verbal, of how students appear to assessment across a range of qualities, or in respect of assessment methods (Oloruntegbe, 2004 and U.S. Department of Education, 2004). With added advantages of equity over equality and criterion over norm and traditional recording and reporting of young people progress, prospective employers rely on it for information on what school graduates/students can do and not only what they know as represented in scores and grades.

Successful e-Portfolio projects also integrate self-assessment and peer-assessment, are flexible in the types of content they can include and act as both a means to demonstrate learning over a period of time and a presentation platform for self-promotion and future employment (Wade, Abrami&Sclater, 2005). In addition, e-portfolio projects can facilitate self-regulation and critical reflection in students (Carmean& Christie, 2006; Jenson, 2011). For the purpose of this research, e-portfolios is viewed as means of transmitting useful instruction to learners or a means of acquiring knowledge and skills with the aid of ICT in expectation that it will have impact on their achievement and retention.

Generally, teachers use computers for instruction. Computer is not just a teaching tool like chalkboard or textbook which are two-dimensional in operation. It is rather a device which provides students with interactive involvement with instructional materials on three-dimensional environments. The use of computer as a learning medium is referred to as Computer Assisted Instruction (CAI).

According to Isijola (2018), Computer Aided Instruction (CAI) is a very potent instructional technique in the teaching and learning process because it provides an interaction between an individual learner and the computer just as it happens in the tutorial system between the teacher and the individual learner, and is able to display the instructional material to the individual student. Tyagi (2014) remarked that CAI is an important instructional strategy for teachers as it facilitates the learner by providing individualized instruction, effective interaction with the learner and immediate feedback. CAI provides text, graphics, audio, visual, pictures, animation and simulation in the same media to students (Olagunju, 2013).

Computer interactivity and visualization on 3D environments enjoyed some patronage from chemistry, medicine, pharmacy, engineering space and science education in global world. Besides these pedagogical and practitional issues, there is also the economic aspects, making the present state or art technology rather too expensive for many school and departments, particularly in the developing nation to bear (Oloruntegbe&Gazi 2010; Akindele, 2013). The problems of access, poor internet connectivity and digital divide are there. Yet the ability between the concrete world of nature of these technologies in bridging the gaps and the abstract world of concepts and models cannot be over emphasized. All these aforementioned problems had been described as more of enablers of learning than inhibitors (Oloruntegbe, 2010; Akinsete, 2013). They should be embraced and accorded more researches.

In the various forms of CAI, the computer acts as a tutor, teaching new skills or concepts or providing practice for learners. As the name implies, the basic interaction in CAI occurs between the learner and the computer (Isijola, 2018). It is self-paced, systematic and user friendly. Instruction usually

proceeds step-by-step using text or video display. The learner answers questions and calls up the next learning sequence by using the computer terminal.

Computer Assisted Instruction (CAI) can be categorized into two major types – the adjunct and the primary. According to Tabassum (2004) as cited in Isijola (2018), Adjunct CAI first used by Victor Bunderson, consists of materials that supplement or enrich the learning situation, for example, short CAI programmes and those supporting concepts, which are to be discussed later in the regular class. Primary CAI materials conversely provide instructions of a substitute and of usually longer duration. It is also part of distance learning throughout the world.
Laleye (2019) investigated the effects of a Computer Programmed Instructional (CPI) strategy on Basic Science students' learning outcome in two instructional settings in Ondo state and found that students exposed to the use of CAIP in the two settings (individual and cooperative) performed significantly better than their colleagues taught using conventional method.
Conventional methodas cited in Isijola (2018) is also known as face-to-face method or lecture method. It is an organized verbal presentation of a subject-matter where the presenter dominates the exercise for long period with or without the students' involvement. The teacher controls the instructional process, the content is delivered to the entire class and the teacher tends to emphasize factual knowledge. In other words, the teacher delivers the lecture content and the students listen to the lecture. Thus, the learning mode tends to be passive and the learners play little part in their learning process. By this method, the teacher organizes resources, prepares outline and presents the lecture, while the students are made to listen. Occasionally, teachers may use illustrative materials. Where it is used, the teacher should clarify the terms used and explain every new concept. It has limited value to achieve behavioural and attitudinal changes. Lecture is one-way communication.

Previous studies by Salau and Oyekan (2020) found that conventional method of teaching did not affect significantly students' academic performance in various subjects. However, Owusu, Monney, Appiah and Wimot (2010) and Ottman (2012) discovered that students' performance was better in the posttest when conventional method of teaching was used to instruct students. They argued that proper and careful design of instructional material is more relevant to learning outcome than unplanned selection of a particular instructional technique.

The introduction of Computer technology has become an integral part of the global community and the world at large. Computer science is a newly introduced subject into the Senior Secondary School curriculum. As a result of this, there are currently inadequate qualified or specialist on the teaching of the subject, although those considered competent by NPE, 2021 to teach the subject are mathematics, technical and science teachers. In Nigeria, the academic performance of students is one of the critical factors for judging educational standards and quality. Considering the academic performance of Senior Secondary School students who sat for WAEC from 2018 to 2022, it is clear that the performances of these students are low.

Statement of the Problem

The researcher observed, that in most secondary schools, teachers in the field of sciences (Physics, Biology) or languages (Yoruba, Igbo or English) and vocational (Fine Arts) do teach computer science, who may likely not have the requisite mastery of the subject and which is not in line with the curriculum specification. In some of the secondary schools, the school management and Parents' Teachers Association (PTA) tried to raise fund to employ personnel in order to handle the subject.

The ineffective delivery of the computer science concepts or contents by these sets of unqualified teachers would have adversely affect the achievement and retention of knowledge.

To avoid these problems, (that is the ineffective delivery of lesson contents, none registration of students for WAEC and low performance of students) and with the use of technology at this 21st century, scheme of work can be broken down to smaller units (lesson notes) and it can be programmed for the students to enable them process materials of learning on their own, understand the subjects and retain what has been learnt. This can be done at any particular time, anywhere in various schools with little or no supervision.
It is viewed by the researcher that if integration of computer technology and text (making CAIP) could assist in effective instruction, a combination of computer technology and video (making e-portfolio) will assist the students, to perform and retain better.

Observations of an interaction of the researcher with the participants in an earlier study of Computer Assisted Instructional Package (CAIP) revealed that the students prefer video instructional packages especially when they can have access to it anytime and anywhere and check their performances any day and anytime. This study therefore seeks to investigate the effect of e-Portfolio (recorded video) on academic achievement of senior secondary school students in Computer science in relation to Computer-Assisted Instructional Package and conventional method.

Research Questions

The following research questions guided this study:

i. Is there any difference in students' performance in Computer Science in the three treatment groups before treatment?
ii. Is there any difference in the academic achievement of students when exposed to e-Portfolio, Computer Assisted Instructional Package and conventional method of teaching in Computer Science?

Methodology

This study adopted a pretest and posttest, control group using quasi-experimental research design.
The study employed three treatment groups. The three instructional strategies that were used in the study are Electronic Portfolio, Computer Assisted Instruction Package (CAIP) and Conventional Method of Teaching (CMT). Students in the first group were taught with the use of e-Portfolio, the second group with the use of Computer Assisted Instruction Package (CAIP) and the third group using the conventional method. All groups were subjected to pretest and posttest before and after the treatments respectively.

Population

The target population for this study consisted of all secondary school class two (SSII) students (both male and female) offering computer science in Ondo State.There are three hundred and seventy secondary schools in Ondo State. These comprises of three hundred and sixty five public secondary schools and five unity secondary schools which are across the three senatorial districts of Ondo State. Ondo Central Senatorial District includes Ondo West Local Government Area of Ondo State where the Researcher conducted the study has thirty one public secondary schools and one unity secondary school.

Sample and Sampling Techniques

The sample size used for this study was sixty which comprised of 60 students from Senior Secondary School class two (SSII) students offering Computer Science. Multistage sampling technique was used to select sixty students in three intact computer-based classes of twenty students each from three purposively selected schools from Ondo town in Ondo West Local Government Area of Ondo Central Senatorial District, Ondo State constituted the sample. These sixty students were randomly assigned into groups. There are three Senatorial Districts in Ondo State viz: Central, North and South. Central Senatorial District was conveniently chosen by the Researcher. Ondo West Local Government Area was also conveniently selected from the six local governments of Ondo East, Ondo West, Idanre, Ifedore, Akure South and Akure North that constituted the Central Senatorial District. The choice and the use of Ondo town in Ondo West Local Government, which was an urban center where the quasi experiment was conducted became necessary for convenience reasons in that there are many schools to sample from and will involve movement of materials such as additional laptops, generator, extension boxes and monitoring by the Researcher being an experimental work. The fact that there is the need to power the experimental classes with the use of generator which must be supplied for effective teaching and learning further informed the choice. Also not all the senior secondary class two students are offering computer science at the West African Senior School Certificate Examination (WASSCE) level since it is an optional subject for the students.

Two of the schools served as experimental and the third, the control group. Therefore the choice of the schools that participated in for the study were based on schools that met the following criteria:

i. Well-equipped computer laboratory;
ii. Qualified Computer Science teachers;
iii. Coeducational system and schools that have taken part in computer science at WASSCE/ Senior Secondary School Certificate Examination (SSCE) or other external examinations such as National Examination Council (NECO) in the past five years.

Research Instrument

The Computer Science Achievement Test (COMSAT) which comprised of adopted (culled from WAEC/SSSCE past questions) and adapted (added and developed) items by the researcher was used in the study. The COMSAT consists oftwo sections (A and B) with Section A dealing with biodata of students while Section B contained sixty items of multiple choice questions with five options A-E, (with one correct answer and four distractors). Concepts in COMSAT were taught during the treatment period of six weeks. Thirty of the items were used for pretest and posttest. Marking schemes were included in the test. In order to determine the impact of treatment on the academic achievements towards methods and Computer Science (subject), the COMSAT was administered after the last stage posttest.

Validity of the Instrument

In order to ensure the face and content validities of the instrument, the draft of the instrument (COMSAT) was given to the researcher supervisor and three qualified Computer science teachers in the secondary school. These individuals scrutinized the instruments and made necessary inputs. Thus, content validity of the 60-items COMSAT were ensured. The face, content, construct, colour combinations and fonts of the e-Portfolio and CAIP packages were checked and validated by various experts to ensure the validity of the instruments and corrections were effected accordingly.

Reliability of the Instrument

A pilot test of the instrument was carried out with twenty SSII Computer Science students from a Secondary School within the population but outside the sample. Test – retest method was adopted with a time interval of two weeks. The scores obtained from the two administration of the same tests were analysed using Pearson Products Moment Correlation to test the reliability coefficient of the instrument, the coefficient obtained was 0.75 and this was found suitable for the study.

Data Analysis

The pretest andposttest scores collated wereanalysed based on the research questions and hypotheses using descriptive (mean and standard deviation).

Results

Research Question 1: Isthere any difference in students' performance in Computer Science in the three treatment groups before treatment?
In order to answer this question, data obtained on the pretest by the students in the three groups before treatmentwere subjected to descriptive statistics. The results are as shown in Table 2.

Table 1: Pretest mean scores of students in the three groups

GROUPS	N	PRETEST	
		$\bar{x}$	S. D.
E-PORTFOLIO	20	8.50	2.42
CAIP	20	8.55	2.35
CMT	20	8.35	2.52
TOTAL	60		

As shown in table 1, the pretest mean scores for the three groups of students in Computer Science using e-Portfolio, CAIP and Conventional Method of teaching were 8.50, 8.55 and 8.35 respectively. The pretest mean scores of students in the three treatment groups are almost the same. It was observed that the performance of the students in the three groups were almost the same before the treatment. This showed the homogeneity of the groups.

Research Question 2: Is there any difference in the academic achievement of students after been exposed to e-Portfolio, Computer Assisted Instructional Package and conventional method of teaching in Computer Science?

In answering this question, the pretest and posttest scores obtained from the subjects were compared, pretest and posttest scores were subjected to descriptive statistics and their mean difference were also calculated. The results are as presented in Table 3 and Figure 1.

Table 2: Achievement mean scores of students in the three groups before and after treatment.

GROUPS		PRETEST		POSTTEST		Mean
	N	$\bar{x}$	S.D.	$\bar{x}$	S.D	Gain
E-PORTFOLIO	20	8.50	2.42	18.20	3.38	9.70
CAIP	20	8.55	2.35	14.60	2.72	6.05
CMT	20	8.35	2.52	12.30	2.49	3.95
TOTAL	60					

Table 2 revealed that students exposed to e-Portfolio, had the highest mean posttest score (18.20), followed by the CAIP with the mean posttest score (14.60) while the conventional group had the least mean score of 12.30. Table 3 also revealed the e-Portfolio group had the highest mean difference of 9.70, followed by CAIP which had 6.05 and the CMT group had the least mean difference 3.95. This implies that irrespective of the methods of teaching used, the students improved but e-Portfolio group performed best and higher than the other methods of teaching.

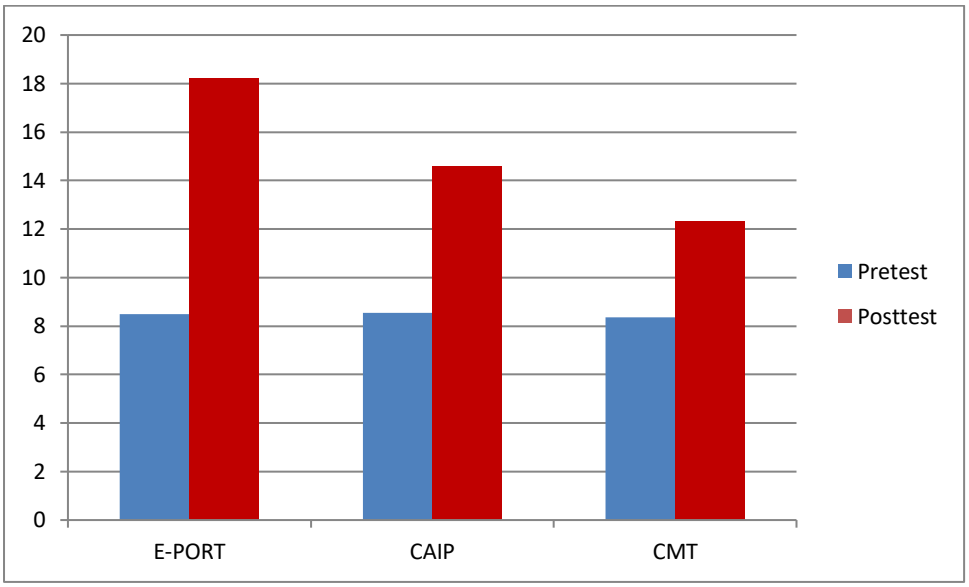

Figure 1: **A bar chart showing achievement mean scores of students in the three groups**

The results on table 2 was further illustrated in Figure 1. It could be concluded that the three experimental groups recorded appreciable achievements in Computer Science, however, the e-Portfolio group performed better than those in CAIP and Conventional method.

Hypotheses Testing

The research hypotheses were tested at 0.05 level of significance:

Hypothesis 1: There is no significant difference in the pretest mean score of students taught computer science with e-Portfolio, Computer Assisted Instructional Package and Conventional method of teaching.

In testing this hypothesis, the Computer Science Achievement Test (COMSAT) pretest scores obtained from the three groups (e-Portfolio, Computer Assisted Instructional Package and Conventional method of teaching) were subjected to Analysis of variance in order to determine the differences among the three groups. The results are as presented in table 3.

Table 3: Analysis of Variance (ANOVA) on the mean achievement scores of students' in e-Portfolio, CAIP and CMT groups before treatment

Source of Variable	SS	MS	df	F	Sig.
Between Groups	0.433	0.217	2	0.037	0.964
Within Groups	336.500	5.904	57		

The results in table 3 revealed that the p-value (0.964) was greater than F-test of 0.037 at 0.05 alpha level of significance. This means that there was no significant difference in the academic achievement of students' mean scores before exposed to the e-Portfolio, CAIP and CMT. Hence, the null hypothesis is upheld. This indicated that the subjects in the three treatment groups were homogeneous before exposure to different treatments. This means that the selected samples are genuinely showing the characteristics of the target population.

Hypothesis 2: There is no significant difference in students' academic achievement in Computer Science when exposed to e-Portfolio, Computer Assisted Instructional Package and Conventional method of teaching.

In testing hypothesis 2, the pretest and posttest scores obtained from the three groups (e-Portfolio, Computer Assisted Instructional Package and Conventional method of teaching) were subjected to Analysis of variance (ANOVA) in order to determine the differences between and within the three groups before and after treatment. The results are as presented in table 4.

Table 4: Analysis of Variance (ANOVA) on the mean achievement scores of students in the e-Portfolio, CAIP and CMT groups before and after treatment.

	Source of Variable	SS	MS	df	F	Sig.
Pretest	Between Groups	0.433	0.217	2	0.037	0.964
	Within Groups	336.500	5.904	57		
Posttest	Between Groups	353.733	176.867	2	21.171	0.000
	Within Groups	476.200	8.354	57		

The results in table 10 revealed that the P-value (0.000) was lower than 0.05 alpha level. This means that there was a significant difference in students' academic achievement in Computer Science exposed to e-Portfolio, CAIP and CMT. Hence the null hypothesis is rejected. This indicated that the students in the three treatment groups performed significantly differently after the treatments.

Tukey's range test was used to find the means that are significantly different from each other. The result are as presented in table 5.

Table 5: Tukey's HSD showing the Post-HOC Analysis of Posttest achievement of Students' in the three groups.

(I) Groups		(J) Groups		Mean Difference (I-J)	Standard Error
Groups	Mean(**I**)	Groups	Mean(**J**)		
CMT	12.30	CAIP	14.69	-2.390*	0.914
		E-Portfolio	18.20	-5.900*	0.914
CAIP	14.60	CMT	12.30	2.300*	0.914
		E-Portfolio	18.20	-3.600*	0.914
E-Portfolio	18.20	CMT	12.30	5.900*	0.914
		CAIP	14.69	3.600*	0.914

*****Based on observed means

*The mean difference is significant at the 0.05 level

In order to test the effect of treatment on the posttest mean scores of the subjects, Multiple Classification Analysis (MCA) was used. The result is presented in table 12.

Table 12: Multiple Classification Analysis showing the effects of treatment on students' achievement in the three groups

Grand Mean = 15.03

Variable + Category	N	Unadjusted Variable	Eta	Adjusted for Ind. + Covariate	Observed Power
E-Portfolio	20	+3.17		77.13	
CAIP	20	-0.43	0.777	6.61	1.000
CMT	20	-2.73		-38.45	
Total	60				

Table 5 showed that students exposed to e-Portfolio had the highest adjusted posttest mean scores of 18.20 (15.03 + (3.17). This is followed by CAIP method with an adjusted posttest mean scores of 14.60 (15.03 + (-0.43), while the CMT group had the least adjusted posttest mean score of 12.30 (15.03 + (-2.73). It implies that e-Portfolio and CAIP methods enhanced the students' achievement when compared to the CMT. Also e-Portfolio performance superseded that of CAIP.

Discussion of Findings

From the findings, it was discovered in hypothesis one, that there was no significant difference in the pretest mean score of students' taught Computer Science with the use of e-Portfolio, CAIP and CMT. Hypothesis one was therefore upheld. This indicated that the students in the three treatment groups were homogeneous before they were subjected to different treatments. This means that the selected samples are genuinely showing the characteristics of the target population.

Hypothesis two states that there was no significant difference in students' academic achievement in Computer Science when exposed to e-Portfolio, Computer Assisted Instructional Package and Conventional method of teaching. Hypothesis two was rejected because the results of this study indicated that significant differences existed in students' academic achievement when taught Computer science with the use of e-Portfolio, CAIP and CMT. The results of post hoc indicated that students' academic achievement were drastically improved when subjected to the three methods of teaching. The students in e-Portfolio group performed better than students in CAIP and CMT groups. Also, the result showed that students in CAIP group performed significantly better than students in CMT group. Although it was shown that the three methods enhanced performance in Computer Science, the result tends to favour e-Portfolio group more than the CAIP and CMT approach would

do. It could be inferred from the findings that the e-Portfolio has the tendency of enhancing performance more than conventional approach would do. This agrees with the findings of Nor, Raja &Jhee, (2012) and Yusof, Hashim, Hamdan& Muhamad, (2013) who reported better performance of students taught in Social studies, Science, Mathematics, English and Creative Writing with the use of e-Portfolio compared to students taught using other methods of teaching. The result also agrees with the findings of Barrett (2010) who found e-Portfolio more effective than CAIP and CMT. According to Barrett (2010), students taught using e-Portfolio had enhanced performance which made the students different and to outscore their counterparts in the other groups. Furthermore, the finding was supported by the findings of Yastıbaş (2013) and Sezer&Bahadir (2018) which stated that e-Portfolio method when used, significantly improved students' performance in grammar, pronunciation, vocabulary and Realistic Mathematics Education. The implication is that all the three methods (e-Portfolio, CAIP and CMT) were good for teaching since the achievement of all the students improved after treatment but the achievement of students greatly improved using e-Portfolio.

Conclusion

From the findings of this study, it was observed indicated that e-Portfolio, CAIP and CMT enhanced students' academic achievement and retention, with e-Portfolio as the best. It was revealed that the students exposed to the use of e-Portfolio in the three instructional settings (e-Portfolio, CAIP and CMT) significantly performed better than their colleagues in CAIP and CMT.

Recommendations

The following recommendations arose from the findings of the study:

1. Teachers in Secondary Schools should be encouraged to use Electronic Portfolio to deliver lectures since the method significantly improve the learning and retention of students offering Computer Science.
2. Government should approve the use of Electronic Portfolio as an instructional method of teaching and all videos should be recorded by professional teachers which will be done in modules to cover the curriculum for each year.
3. Students should be encouraged to use e-Portfolio to learn the major concepts of Computer Science as this will give them the opportunity to study on their own, at their space and have the ability to visit and revisit lectures at any available time.
4. Other Teaching Methods like Computer Assisted Instructional Package (CAIP) and Conventional Method of Teaching should be improved upon to achieve success in computer science as a subject.

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