Effect of Computer-Assisted Learning and Improvised Instructional Materials on Senior Secondary School Students' Achievement in and Attitude to Physics in Lagos State

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Abstract
This study investigated the difference between the mean achievement scores of the students taught with computer-assisted learning package and those taught with improvised instructional materials; difference between the mean achievement scores of male and female students taught with computer-assisted learning package; difference between the mean achievement scores of male and female students taught with improvised instructional materials; and attitude of students taught with computer-assisted learning package and those taught with improvised instructional materials. This study adopted experimental research design. One hundred and fifty Senior Secondary School (S.S.S.) 1 science students were sampled from two selected government schools in Lagos State. The research instruments used for this study consisted of Computer-Assisted Learning Package (CALP), Improvised Instructional Materials (IIM), Physics Performance Test (PPT) and Attitude Questionnaire (AQ). The instruments were validated by experts and pilot tested. The internal consistency of PPT was 0.87 by using Kuder–Richardson formula 20 (KR 20) and the internal consistency of AQ was 0.85. The hypotheses were tested with t-test statistics at 0.05 level of significance for this study. Findings revealed that there was significant difference in the mean achievement scores of males ($\bar{x}$ = 31.00) and females ($\bar{x}$ = 30.00) students who were taught with computer-assisted learning; there was significant difference in the mean achievement scores of males ($\bar{x}$ = 31.00) and females ($\bar{x}$ = 30.00) students who were taught with computer-assisted learning; there was significant difference in the mean achievement scores of males ($\bar{x}$ = 28.00) and females ($\bar{x}$ = 25.00) students who were taught with improvised instructional materials; and there was significant difference on the attitudes of students taught with computer-assisted learning package ($\bar{x}$ = 3.95) and those taught with improvised instructional materials ($\bar{x}$ = 2.99) based on gender. This study concluded that utilisation of up-to-date and appropriate instructional materials during instructional delivery facilitate valuable students' academic excellence and interest in Physics subject at Nigerian S.S.S. Hence, this study recommended that Governments at all levels should provide up-to-date and appropriate instructional materials in all Nigerian schools in order to facilitate instructional delivery and acquisition activities.

Keywords: Computer-Assisted Learning, Improvised Instructional Materials, Physics, Students' Achievement, Students' Attitudes.

Introduction

Effective instructional delivery of science subjects can be highly appreciated when appropriate teaching methodologies supported with relevant instructional approaches are put in place. Over the last three decades, there have been calls for a "new approach" to education. Central to these calls is a shift from a focus on supporting the acquisition of formal knowledge to promoting a culture of scientific literacy by engaging students in the language and ways of scientific inquiry. (Boonstra, 2009; & Groff, 2013). From a practical perspective, this shift is driven by a sense of emerging technologies.

The emerging technologies according to Alam (2016) have shifted the paradigm from a teacher-centred to student-centred paradigm. Student-centred teaching strategies as noted by Ahmed (2013) and Rutkauksiene, Schreurs, Huet and Gudoniene (2010) involve interactive lecturing, group work, discussion forums, role-playing and hands-on projects which are facilitated by the usage of computers. Instructional deliveries and acquisitions barriers in school environment according to Arsham (2015), Encyclopedia.com (2016) and Intense School (2016) have been drastically alleviated since the advent and integration of computer applications in education and training institutions. Computer applications such as Computer-Assisted Learning (CAL), Computer-Assisted Instruction (CAI), Computer-Based Learning (CBL) and Computer-Managed Instruction (CMI) immensely enhance teaching and learning activities.

Utilisation of computer applications in this 21st century has extensively transformed both teachers' and students' performance, reactions, interest and attitudes towards teaching and learning activities. Yusuf, Gambari and Olumorin (2012) observe that students perform excellently in science subjects, especially Physics whenever they are taught with any of the computer instructional applications irrespective of genders. Stefănescu and Barna (2013) observe that usage of computer applications for instructional activities arouse students' personal motivation towards learning new instructional concepts without discouragement and inspire individualised learning any time of the day.

Development and production of instructional materials with locally-sourced materials play a prominent role in instructional deliveries, especially its capacity to proffer immediate solutions to the various teaching and learning problems in

any academic institutions (Olumorin, 2014; Ogunleye & Raheem, 2013). Whenever instructional materials and equipment produced or improvised in the school environment as observed by Owolabi and Oginni (2012), students and teachers' difficulties are easily solved. Also, readily available instructional materials in large quantities reduce the cost of importation of ready-made instructional materials from advanced countries. Utilisation of improvised instructional materials as noted by Al Harthy, Jamaluddin and Abedalaziz (2013) boost teachers' and students' sense of belonging. Also, they motivate teachers' and students' readiness to explore all available resources towards facilitation of teaching and learning activities.

Physics is one of the science subjects that basically encompass mechanics, optics, heat and electricity. Physics can easily be lively to students during teaching and practical sessions, provided up-to-date produced/improvised instructional materials and innovative learning technologies are readily available and utilised appropriately (American Association of Physics Teachers, 2009 & Buabeng, Ossei-Anto & Ampiah, 2014). In Nigeria, however, there is a low academic performance in science subjects especially Physics at S.S.S. level. Their poor performance duly attributed to non-availability of instructional resources, the inability of most students to perform practical and solve numerical process in their respective schools (Ogundare, 2017; Sakiyo & Badau, 2015). It has been discovered that the students' poor performance and lack of interest in science subjects particularly Physics has caused decline in students' enrolment in science subjects (Akinsolu, 2010).

Review of Literature

- Computer applications in Education

In recent years there has been a ground-breaking growth in the use of communication technology, computer networks and information technology in numerous citadels of learning worldwide. Also, majority of the classrooms nowadays have been transformed into an interactive world where the teachers and students are engaged with technology. Many students are fully hooked up and plugged in all of their time through computer applications, either with text messaging, iPods, social networking and websites, among others (Ahalt & Fecho, 2015).

Computer applications have been immensely adopted in education industries and tremendously simplified instructional deliveries and acquisitions. According to Nobert, DelRosso, Farrell, Peddle, Jeffrey and Lilly (2000), Computer

applications at this 21st century play prominent roles in educational institutions, especially in breaking the monopoly power of teachers' teaching dominancy.

Galán (2017) and Groff (2013) observe that frequent utilisation of computer applications like Computer-Assisted Learning, Computer-Assisted Instruction and Computer-Based Learning, among others in the classroom of today extensively keep students stimulated and informed extensively. In addition, it facilitates exchange of learning resources and spaces, promote learner-centred and collaborative learning principles and enhance critical thinking, creative thinking and problem-solving skills.

Computer-Assisted Learning, according to Arsham (2015), Encyclopedia.com (2016) and Intense School (2016), can be referred to as learning mediating tools that stimulate students rate instructional acquisition either individually or collectively. It delivers a bulk of instructional information within very short period of time and operational flexibility for different categories of users.

- Local content improvisation

Ogunleye and Raheem (2013) noted that improvised instructional materials facilitate delivery of instructional objectives; and set both teachers and school management free from problems that might arise due to shortage or lack of instructional materials. Tahir (2002) opines that production methods of instructional materials involves imitative, adaptive and creative methods which depend on the instructional objectives; and availability of production materials, experts and processing. Aina (2013) states that instructional materials improvised with local content have a great impact on students' learning and attitude towards learning Physics and other science subjects.

- Students' attitudes toward learning Physics and their academic performance

Ballah and Ugwumba (2015) discover that Nigerian students have low-level of academic performance and negative attitude towards Physics which arose due to shortage or lack of instructional materials and qualified teachers, among others. Böhm (2008) and Alibasyah and Husin (2016) found that students' performance in Physics have tremendously improved since the utilisation of computer packages for teaching and learning activities. Both male and female students understand the concept of Physics better at the same rate whenever taught with the computer applications ahead of the real practical activities. Sakiyo & Badau (2015) found that students develop interest in learning Physics and other science subjects in any institutions where well-trained and qualified teachers are

employed, also where enough up-to-date instructional materials available for students to use during instructional and examination periods.

This computer age/dispensation has significantly transformed educational institutions. Yusuf, Gambari and Olumorin (2012) and Nwanne and Agommuoh (2017) reported that students performed excellently in both theory and practical examinations whenever they were taught with the Computer-Assisted Instruction without gender bias. Computer Assisted Instruction also enhances students' interest and readiness to learn Physics any time of the day. Regular utilisation of local content improvisation for instructional deliveries, according to Owolabi and Oginni (2012), extensively boosts the level of students' understanding of practical Physics, also students' attitude to practical work improves tremendously without gender discriminations. Ballah and Ugwumba (2015) also found significant gender difference in academic performance in favour of the male students whenever they are taught with available and appropriate instructional materials. In contrast, Aina (2013) postulates that, if the improvised materials are not well packaged and calibrated, it might affect students' academic achievement negatively and make them to lose interest in Physics.

Statement of the Problem

In Nigeria, there is a low achievement in Physics at S.S.S. level which is being attributed to the inability of most students to perform excellently both in Physics theory and practical examinations.

Additionally, students' attitudes towards learning Physics are alarming and discouraging and students feel that Physics is boring and difficult to comprehend. These arise as a result of inconsistency, un-availability of instructional resources, the abstract teaching of Physics principles and non-exposure of students to practical activities in their respective schools.

However, if Physics teachers and students in S.S.S. are exposed to real practicals either with Computer-Assisted Learning and improvised instructional materials, students' academic performance in Physics and attitude towards learning Physics will definitely improve.

Therefore, this study determined the impact of effective teaching and learning of Physics through the use of innovative technologies and local content improvisation for optimal students' achievement.

Purpose of the Study

Specifically, the study determined:

1. the difference between the mean achievement scores of the students taught with computer-assisted learning package and those taught with improvised instructional materials;

2. the difference between the mean achievement scores of male and female students taught with computer-assisted learning package;

3. the difference between the mean achievement scores of male and female students taught with improvised instructional materials; and

4. the attitude of students taught with computer-assisted learning package and those taught with improvised instructional materials.

Hypotheses

The following hypotheses were formulated to guide the study:

$H0_1$: There is no significant difference in the mean achievement scores of students who were taught Physics with computer-assisted learning and those taught with improvised instructional materials.

$H0_2$: There is no significant difference in the mean achievement scores of male and female students who were taught with computer-assisted learning.

$H0_3$: There is no significant difference in the mean achievement scores of male and female students who were taught with improvised instructional materials.

$H0_4$: There is no significant difference on the attitudes of students taught with computer-assisted learning and those taught using improvised instructional materials based on gender.

Methodology

The research was an experimental study involving two-group simple randomized design. One hundred and fifty (150) S.S.S. 1 science students were randomly sampled from two selected government senior secondary schools in Epe, Lagos Mainland and Somolu Local Government Areas of Lagos State. Seventy-five (75) students were used as the Computer-Assisted Learning Package group, while seventy-five (75) students were used as the Improvised Instructional Materials group.

Computer-Assisted Learning Package (CALP), Improvised Instructional Materials (IIM), Physics Performance Test (PPT) and Attitude Questionnaire (AQ) were developed and administered on the students. The CALP was developed by a programmer with combinations of iSpring Pro 7 and Question Writer software in order to make the package possess instructional, interactive, animations and transitions outlooks. The CALP consisted of mechanics, electricity and magnetism topics sections. The CALP can easily load and allow students to navigate conveniently from one section to others without crashing. At the end of each topic, short quizzes and answers were provided in order to measure students' formative achievement.

The IIM was designed and fabricated from locally-sourced materials mainly to teach mechanics, electricity and magnetism topics. Major locally-sourced materials used for the fabrication of the IIM involved metals, seasoned woods, polymer and finishing materials. Production processes of the IIM involved sourcing of materials from Owode-Onirin, Ladi-Lak Sawmill, and Idioro-Mushin, Lagos State; and production at a University Workshop, Lagos State. The IIM figures available in figures 1, 2 and 3. The PPT consisted of 40 structured objective tests covering mechanics, electricity and magnetism topics with answer options A – D. The PPT was structured based on a table of specification which involved lower levels (knowledge, comprehension and application) of the cognitive domains. The benchmark for the PPT was 40 and students were allowed to answer all within 60 minutes. Two sets of AQ were developed based on different groups. The AQ consisted of 10 items that sought for students' attitudes towards CALP and IIM respectively.

All the research instruments were validated and pilot tested in schools other than study area. The reliability of the CALP and IIM were ascertained by the programmer, educational technologist and Physics teachers who test-run both package and material during validation exercise. The reliability of the PPT and AQ were ascertained when administered on sampled 45 S.S.S. 1 science students selected from schools other than study area. Split-Half reliability technique was used to analyse the PPT and internal consistency of PPT was 0.87 by using Kuder–Richardson formula 20 (KR 20). Cronbach Alpha techniques were used to determine the reliability of the AQ and internal consistency of AQ was 0.85. Achievement Test and Attitude Questionnaire were analysed quantitatively with Statistical Product and Service Solution (SPSS). The frequency count, percentages, mean, standard deviation and t-test were also calculated for this study. Research Hypotheses were tested at 0.05 significant level.

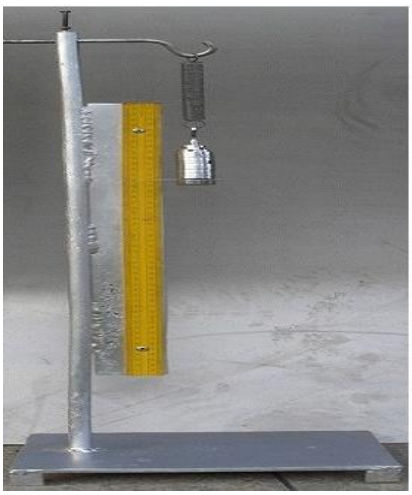

Fig. 1: Improvised Hook's Law Apparatus

Fig. 2: Improvised Coefficient of Friction

Figure 3: Improvised Electromagnetic Induction

Hypotheses Testing

Hypothesis 1

H0$_1$: There is no significant difference in the mean achievement scores of students who were taught Physics with computer-assisted learning package and those taught with improvised instructional materials.

Table 1: Independent t-test analysis showing the difference in the mean achievement scores of students who were taught Physics with CALP and those taught with IIM

Group	N	Mean	SD	Df	t-value	p-value	Remarks
CALP	75.0	30.60	6.74	148	.848	0.032	$H0_1$ Rejected
IIM	75.0	26.50	5.75				

Table 1 shows the t-calculated value of 0.848 and p-value of 0.032 is the result of the difference in the mean achievement scores of students who were taught Physics with computer-assisted learning package and those taught with improvised instructional materials. Since the calculated p-value is less than 0.05 level of significance, the null hypothesis which states that there is no significant difference in the mean achievement scores of students who were taught Physics with computer-assisted learning package and those taught with improvised instructional materials is not accepted.

Hypothesis 2

$H0_2$: There is no significant difference in the mean achievement scores of male and female students who were taught with computer-assisted learning package.

Table 2: Independent t-test analysis showing the difference in the mean achievement scores of male and female students who were taught with CALP

Gender	N	Mean	SD	Df	t-value	p-value	Remark
Male	50	31.00	9.54	73	.225	0.028	$H0_2$ Rejected
Female	25	30.00	4.73				

Table 2 shows the t-calculated value of 0.225 and p-value of 0.028 is the result of the difference in the mean achievement scores of male and female students who were taught with computer-assisted learning package. Since the calculated p-value is less than 0.05 level of significance, the null hypothesis which states that there is no significance in the mean achievement scores of male and female students who were taught with computer-assisted learning package is not accepted.

Hypothesis 3

$H0_3$: There is no significant difference in the mean achievement scores of male and female students who were taught with improvised instructional materials.

Table 3: Independent t-test analysis showing the difference in the mean achievement scores of male and female students who were taught with IIM

Gender	N	Mean	SD	Df	t-value	p-value	Remark
Male	50	28.00	6.08	73	5.196	0.015	Ho_3 Rejected
Female	25	25.00	6.25				

Table 3 shows the t-calculated value of 5.196 and p-value of 0.015 is the result of the difference between the mean achievement scores of male and female students who were taught with improvised instructional materials. Since the calculated p-value is less than 0.05 level of significance, the null hypothesis which states that there is no significant difference in the mean achievement scores of male and female students who were taught with improvised instructional materials is not accepted.

Hypothesis 4

$H0_4$: There is no significant difference on the attitudes of students taught with CALP and those taught using IIM based on gender.

Table 4: Independent t-test analysis showing the difference in the student's attitude toward CALP and IIM

Group	N	Mean	SD	Df	t-value	p-value	Remarks
CALP	75	3.946	9.678	148	-6.425	0.008	Ho_4 Rejected
IIM	75	2.986	11.633				

Table 4 shows the t-calculated value of -6.425 and p-value of 0.008 is the result of the difference between the attitudes of students taught with computer-assisted learning package and those taught with improvised instructional materials based on gender. Since the calculated p-value is less than 0.05 level of significance, the null hypothesis which states that there is no significant difference between the attitudes of students taught with computer-assisted learning and those taught with improvised instructional materials based on gender is not accepted.

Discussion of findings

The result from the table 1 revealed that there was significant difference in the mean achievement scores of students who were taught Physics with computer-assisted learning package ($\bar{x}$ = 30.60) and those taught with improvised instructional materials ($\bar{x}$ = 26.50). The result indicated that significant difference existed in favour of students exposed to computer-assisted learning package. The finding as regards excellent achievement of computer-assisted learning package group students in the achievement test agrees with previous findings of Galán (2017), Nwanne and Agommuoh (2017) and Yusuf, Gambari and Olumorin (2012) that students who were taught Physics with computer packages out-performed students taught Physics with other teaching methods and instructional materials. Also, Aina (2013) noted that students might perform below expectation in Physics when taught with improvised instructional materials if the materials were not well produced and calibrated.

The result from the table 2 revealed that there was significant difference in the mean achievement scores of males ($\bar{x}$ = 31.00) and females ($\bar{x}$ = 30.00) students who were taught with computer-assisted learning. The result indicated that significant difference existed in favour of male students than female students when they were taught with computer-assisted learning. This finding contradicts Böhm (2008) and Alibasyah and Husin (2016) findings who discovered that both male and female understand the concept of Physics at the same rate whenever they were taught with the same computer instructional packages.

The result from the table 3 revealed that there was significant difference in the mean achievement scores of males ($\bar{x}$ = 28.00) and females ($\bar{x}$ = 25.00) students who were taught with improvised instructional materials. The result indicated that significant difference existed in favour of male students than female students when they were taught with improvised instructional materials. This finding contradicts Owolabi and Oginni (2012) who discovered that both male and female students academically performed equally whenever they were taught with locally improvised instructional materials.

The result from the table 4 revealed that there was significant difference on the attitudes of students taught with computer-assisted learning package ($\bar{x}$ = 3.95) and those taught with improvised instructional materials ($\bar{x}$ = 2.99) based on gender. The result indicated that significant difference existed in favour of students taught with computer-assisted learning package. This finding agrees with previous findings of Sakiyo and Badau (2015) who found that students developed

interest in learning Physics whenever they are exposed and taught with up-to-date instructional materials during instructional and examination periods.

Conclusion and Recommendations

Utilisation of up-to-date and appropriate instructional materials during instructional delivery leads to valuable students' academic excellence and arouses students' interest. Excellent students' academic performance and interest in Physics among other school subjects can be achieved through complete integration of innovative and emerging technologies into instructional delivery and acquisition activities in Nigerian S.S.S.

In order to facilitate teaching and learning of Physics in all academic institutions, following recommendations are suggested:

1. Governments at all levels should provide up-to-date and appropriate instructional materials in all Nigerian schools in order to keep both teachers and students update technologically;
2. Instructional materials producers should improve the quality of the local content improvised materials; and
3. Physics teachers should integrate both up-to-date and improvised instructional materials in their instructional deliveries for optimal students' achievement.

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