An Assessment of a Physics Computer- Instructional Package for Teaching Selected Topics in Ekiti State Secondary Schools, Nigeria

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Abstract
This study assessed a Computer-Assisted Instructional package (CAIP) for effective teaching of selected difficult physics concepts in Ekiti State Secondary School s in Nigeria. These difficult concepts were those identified by the Chief Examiners of the West Africa Examination Council (WAEC, 2009) examiners' report and also listed by Nigeria Educational Research and Development Council (NERDC, 2010). The methodology was an assessment of Computer-Assisted Instructional package for Secondary School Physics CAIPSSP and adapting the Dick and Carey Instructional System Design model (2008) 10 physics teachers, 5 computer science experts and 5 educational technology experts with an aggregate value of 50%, 82% and 82.6% respectively. Also 60 students were then engaged in a performance test to find out the effectiveness of the CAIPSSP. The past-test analysis of the performance test showed that students exposed to the use of the CAIPSSP performed better than those not exposed to it. It is recommended that more CAIPSSP should be developed and used in teaching all physics difficult concepts in Nigeria Secondary Schools. All teachers and educational stakeholders are encouraged to organize workshops and seminars in order to equip themselves to take up the challenge of using CAIP to enhance Physics teaching and learning.

Keywords: Assessment, Computer-Assisted Instructional Package, Physics Curriculum and Secondary School.

Introduction

Physical science subjects such as physics has concepts that are practical oriented and involve activities in our daily life. Physics as a subject is significantly placed in the Nigeria Senior Secondary School Curriculum. In order to get placement for admission to read any science based course in Nigeria tertiary institutions, physics must be passed at credit level.

The West African Examination Council (WAEC) Chief Examiners Reports in 2009 identified some difficult concepts in physics. The concepts were also identified by the Nigeria Educational research and Development Council (NERDC 2010). Student find some physics concepts difficult with the use of conventional method of Instruction alone. These difficult concepts include electromagnetic fields, simple harmonic motion, density and relative density, energy quantization, electric current, alternating current (a.e) circuits, fluid at rest and fluid in motion, heat energy and projectile motion.

Physics curriculum contents in Secondary Schools include Mechanics Waves and Optics, Electromagnetic. Fields, Electricity. Thermodynamics/Heat, Modern physics, Magnetic field e.t.c. Reports showed that students find some difficult concepts as Electromagnetic fields, Heat, Electricity, some sub-topics under simple Harmonic Motion, and part of Mechanics like Density and Relative Density because they are abstract in nature. (WAEC chief Examiners'' Reports, 2009).

In 2010, Nigeria Educational Research and Development Council (NERDC) conducted a research to identify difficult concepts in Science and Mathematics due to the poor performance of students in Senior Secondary Certificate Examination (S.S.C.E.) at the time. The identified physics concepts were based on the available and relevant published articles and |West African Examination Council (W.A.E.C.) Examiners' reports. Few of the difficult concepts/topics identified include uniform motion, motion of falling bodies, simple harmonic motion, projectiles friction, equilibrium of forces, conservation principles, some aspects of waves field in electromagnetism, alternating current circuit and quanta physics.

Researchers had wondered if it is really the use of particular delivery pedagogy, technology or the design of the instruction that really improves learning (Clark, 2001; Kozma, 2001). Clark (2001) claimed that technologies are merely vehicles that delver instruction, but do not in themselves influences student's achievement. Kozma (2001) argued that, particular attributes of the computer are needed to bring real – life models and simulations to the learner, thus, the medium does influence learning. However, it is not the computer per se that makes students learn, but the design of the real – life models of 3–dimentional animated simulations, and the student interaction with those models.

Models used for developing instructional packages include ADDIE model, Dick and Carry model, Morrison, Ross and Kemp mode (MRK), John Keller model, and so on ADDIE model is the generic process traditionally use by Instructional System Designers (ISD) and training developers. Most of the current Instructional System Design models are spin-offs or variations of the ADDI model. Dick and Carrey (2005) mode a momentous contribution to the field of Instructional System Design by championing a system-view of instruction as opposed to viewing instruction as a sum of isolated parts.

The model addresses instruction as an entire system focusing interrelationship between context, content, learning and instruction. Dick and Carrey model is a system approach model comprising ten critical components in which none of the steps can be avoided, though some steps can be accomplished concurrently (Dick and Carry, 2005).

Dick and Carey (ISD) model is an outlined methodical design and developmental process of the instructional outcome. It is a system – oriented ISD that is break down into smaller components in instruction for easy transmission of instruction.

Hence, this work hoped to bring out the role Computer – Assisted Instructional package (CAIP) could play in teaching of the selected difficult concept in physics particularly

Electromagnetic field and simple harmonic motion. It also hoped to assist learners to achieve a better understanding of these concepts. Dick and Carey ISD model was employed for the development of the contents of these two concepts.

Research Questions

For the purpose of this study following research questions were generated.

1. To what extend does Computer-Assisted Instructional Package for Secondary School Physics (CAIPSSP) developed to teach difficult concepts relevant to the Physics curriculum?
2. Is there any difference in expert rate of the CAIPSSP for eaching difficult concepts in physics?
3. What is the difference between physics students taught using CAIPSSP and those taught using conventional method?

Review of Related Literature

Roles of Computer-Assisted Instructional Package in Teaching of Science Subjects

Science is a study of biological and physical concept of human beings and nature. It is an area of study that helps people in understand the environment in which they live and the activities going on within the environment. According to Hancer, Sensoy and Yildirim (2003), Science education gives students creative thinking ability. It helps them to know and love their environment more; creative power of students also increases through science education. Science education makes students obtain positive attitude towards technology.

According to Encyclopedia Britannica (2011), the use of computers in education started in the 1960s. With the advents of convenient microcomputers in the 1970s, its use in schools has become widespread from primary education through the university level and even in some pre-school programmes. According to Onasanya (2002), no technology has improved the day to day life of human beings all over the world like Computer.

A good number of researchers already carried out investigation to substantiate why African and other developing countries are still backward technologically in this computer age. However, Africa countries have come to realize that they have to move with the trend of technology globally for the varieties of advantages it offers. Ifinedo (2005) carried out a research to determine the readiness of some Africa countries which are Botswana, Cole d'Ivoire, Egypt. Chana, Kenya, Mauritius, Nigeria, South Africa, and Tunisia. The result of the research on readiness of Africa revealed that Africa is right below the ladder in the global networked economy. In recent times, few Africa countries are making efforts to be technologically alive. According to Abimbola & Omoseewo (2006), Nigeria launching her first communication satellite on July 7 2011 is a tremendous effort towards the right direction.

Computer – Assisted Instruction (CAI) refers to instruction or remediation presented on a computer. Many educational computer programmes are available online and from computer stores and textbook companies. According to Vani (2011), computer programmes are interactive and can illustrate a concept through attractive animation, sound, and demonstration. According to Encyclopedia Britannies (2011), there are many advantages to using computer in educational instruction. They enhance teachers' instruction in several ways; making teaching easier for them and covering the scheme of work in good time.

Computers are particularly useful in subjects that require drill, freeing teacher time from some classroom tasks so that a teacher can devote more time to individual students. They provide one-to-one interaction with a student, as well as an instantaneous response to the answers elicited, and allow students to proceed at their own pace. This was supported by

Mahapatra (2006), when he wrote that computer, as a personally owned electronic saves students from the embarrassment of giving incorrect answers in public or be subjected to ridicule because they move at a slow rate of learning compared with their classmates.

The Computer-Assisted Instructional Package which is an example of ICT usage can be made available in many ways: on the internet, CD-Rom, Audio cassette, e.t.c. According to Itaynor (2003), technology has become well integrated into many school systems such that computer is not just used to analyse data in schools but serves as learning tools. For example, students are regularly using the internet to gather and assimilate information for use in research assignments. They are preparing electronic presentations using computer presentation programmes and Liquid. Crystal Display (LCD) projectors. They are using word processing programmes to create various reports. Students are even using spread sheets to increase their experiences with mathematical concepts.

Methodology

Research Design

This research adapted the Dick and Carey (2008) model in the assessment of the instructional package. The developed package was termed Computer-Assisted Instructional Package for Secondary School Physics (CAIPSSP).

The researchers utilize a mixed method approach of descriptive with post-test control group quasi-experimental design.

Sample and Sampling Techniques

The population for assessment of the CAIPSSP comprised of experts in the fields of Educational Technology, Computer Science and Physics teachers. These experts were drawn from selected school in Ekiti State. A performance test was also administered on 60 students of Holy Child Secondary School, Ado – Ekiti. These schools were chosen because from investigation, their students have been taught with computer as instructional medium for upward of 2 years and they have teachers that are computer literate and have used it for teaching.

Instrumentation

There researcher-designed questionnaires were prepared for three categories of experts namely Computer Scientists, Educational Technologists and Physics Teachers' the questionnaire is to enable the experts assess the CAIPSSP. The questionnaire for physics teachers contained adopted likert statements to which the respondents stated whether they strongly agreed, agreed, strongly disagreed or disagreed.

The questionnaire was administered to asses' content of the CAIPSSP developed. The purpose was to ascertain if the note and the designed package are in agreement with Nigeria Secondary School Schools Physics Curriculum, and to establish appropriateness in its logical and sequential arrangements moving from simple to complex.

The second questionnaire was for computer experts, they were expected to assess the CAIPSSP with regards to navigation, interface, speed of application, flexibility of software simulation and other relevant characteristics.

The questionnaire for educational technologists was intended to ascertain whether the programme of the package conformed to the acceptable standards in educational technology. They assessed based on its simplicity, consistency in the use of upper and lower cases, appropriate use of from type, font size, colour combination animated options used among others.

Thirty-two (32) SSI students and Twenty-eight (28) SS2 students were selected and each class of students divided into control and experimental groups to test the effectiveness of using the CAIPSSP on their performance in the difficult concepts. Then the researchers guide the subject teachers on how to use the CAIPSSP, Simple Harmonic Motion was taught to SSI and Electromagnetic fields to SS2 students. The experimental group was taught using the CAIPSSP while the control group was taught without it. Questions set at the end of each module in the package were used to assess the students. The questions were selected from past questions of Senior Secondary Certificate Examination (SSCE) and Unified Tertiary Matriculation Examination (UTME).

Validation of Instruments

The instruments were subjected to validity with the help of experts in the area of Educational Technology, Computer Science and Physics. The instruments were subjected to face, content and construct validities for instance in the face validity, experts ensured that the instruments contained appropriate items that could elicits factors that could lead to effective and ease of learning difficult concepts in physics and navigation error avoidance with simple animations to avoid distractions.

Reliability of Instruments

The instruments were trial-tested on a small group in two secondary schools in Ondo State that shared similar characteristic with the target samples. The reliability of the three instruments were estimated using Cronbach Alpha statistics to ensure internal consistency. The reliability coefficients obtained from the CAIPSSP were RPT = 0.87, RCS= 0.86 and RET = 0.94.

Procedure for Data Collection on the Assessments of CAIPSSP

The assessment of the package which adapted Dick and Carey model in which eight out of the ten components were involved as follows:

(i) **Identifying Instructional Goal:** Instructional goal to be achieved in this study on a long term basis is to make the concepts of electromagnetic field and simple harmonic motion easier and fun to learn and understand by learners, and less stressful for teachers to teach.

(ii) **Conducting Instructional Analysis:** Lesson plans of Electromagnetic Field and Simple Harmonic Motion were broken down into 5 and 4 modules respectively in which ach was further broken into sub topics. Each module contains introduction, the content of instruction involves experiments which are activity-based and learner-centered; they are activities that students are expected to follow the descriptions slowly so they can demonstrate it on their own if apparatus are made available. Each module ends with a summary of content of instruction and this is followed by interactive questions for students to evaluate themselves.

(iii) **Identify in entry behaviours and learners' characteristics:** The previous knowledge learners should bring into the learning environment before learning electromagnetic field are identified as current electricity, motion magnetic field and force field. The previous knowledge for simple harmonic motion is the concept of circular motion and elasticity. These are stated at the beginning of each concept. There are questions at the beginning of the first module of each topic to review these concepts with the learners. The electromagnetic field is designed or learners of average age of 16 years who are in third term of year two of Senior Secondary School while Simple Harmonic Motion is designed for average age of 15 years who are in third term, year one of Senior Secondary School.

(iv) **Writing performance objectives:** At the beginning of each module, the behavioural objectives are stated which will measure knowledge, comprehension, Analysis, Application, Synthesis and Evaluation levels of the learner as regards the content of instruction.

(v) **Assessment of Instruments:** At the end of each module, multiple choice questions or/and True/False questions are set parallel to the behavioural objectives to ensure that the behavioural objectives are met at the end of the lesson. Immediate feedbacks are got as the designed package allows that the computer scores the learners as they go through the questions. Theory questions are given for learners to practice at their own pace at the end of each module. Answers are provided also where necessary to the theory questions.

(vi) **Assessment of Instructional Strategy:** Based on the five components earlier discussed, the scripts for the content of instruction were written by the researcher. During this process, the researcher produced a detailed storyboard of Electromagnetic fields and Simple harmonic motion. This process was accomplished with the researcher bearing in mind the learner's needs, previous knowledge and skills. The researcher discussed in details with the computer scientist on how each item of the scripts were to be presented in the package.

(vii) **Assessment and Selection of Instruction Materials:** At this stage, the instructional strategy was used to produce the instruction. The development of the package required the use of Camtasia studio 7.1 which was majorly the software used for the design of the package, a personal laptop, a headphone, empty rewritable CD-ROMs, computer software and programs like Microsoft word, Macro media flash, windows flash player, Hypertext Mark-up Language (HTML), PowerPoint, Wed browser and the Internet facilities. These were used for texts, graphics, and simulations among others.

(viii) **Assessment and Conduct of Formative Evaluation of Instruction:** The detailed of contents of instruction on Electromagnetic filed and Simple Harmonic Motion were typed. This as well as the designed package was given to experienced Physics teachers to scrutinize to ensure that it satisfactorily covers the NERDC (2010) new curriculum and also to ensure the contents were well explained in simple language. The other type of formative evaluation was carried out but limited only to experts in Software design and Educational Technology. The post-test effect of CAIPSSP on student performance was ensured to ascertain the functionality and reliability of the CAIPSSP.

Data Analysis

Data were analysed using descriptive statistics. The descriptive statistics used was mean, frequency counts, percentages and standard deviation.

Results and Discussion

Research Question One

To what extent does Computer-Assisted Instructional Package for Secondary School Physics (CAIPSSP) developed to teach difficult concepts relevant to the Physics curriculum?

Table 1: Responses from Physics Teachers

S/so Item	SA freq %	A Freq %	D Freq %	SD Freq%	total
1. The content of the draft package covers Satisfactorily the Simple Harmonic Motion Content for Senior Secondary School Physics Curriculum.	5 (50)	5 (50)	0 (0)	0 (0)	10
2. The sub-topics are sequentially and Logically arranged to allow learning From simple to complex	3 (30)	7(0)	0 (0)	0 (0)	10
3. The language used is simple enough for learners and teachers.	4 (40)	6 (60)	0 (0)	0 (0)	10
4. The diagrams adequately explain what are intended to explain	2(20)	8(80)	0 (0)	0 (0)	10
5. The examples solved are detailed enough to explain the concepts.	2 (20)	8(80)	0 (0)	0 (0)	10
6. The examples are enough in number to explain the concepts.	1(10)	9(90)	0 (0)	0 (0)	10
7. The exercises given are relevant to the topic	4(40)	6 (60)	0 (0)	0 (0)	10
8. he exercises given are enough in number	3 (30)	7 (70)	09 (0)	0 (0)	10
9. The equations are written out well.	3(30)	7 (70)	0 (0)	0(0)	10
10 The experimental descriptions used are Relevant and sequential.	3(30)	7(70)	0 (0)	0(0)	10

Table I showed that the respondents agreed and strongly agreed with most of the items. To tem 1,50% of the respondents strongly agreed while 50% agreed to the fact that the contents of the two difficult concepts were in agreement with the NERDC (2010) curriculum 20% of the respondents strongly agreed and 80% agreed to item 5 which sought to know if the example solved were detailed enough to explain the concepts. To item 10, 30% and 70% respectively strongly agreed and agreed with experimental descriptions used as relevant and sequential. In summary, the ten sampled physics teachers considered the lessons' contents good and satisfactory to teach students.

Research Question Two

Is there any difference in expert rate of the CAIPSSP for teaching difficult concepts in physics?

Table 2: Responses from Computer Science Experts

S/N	ITEM	RESPONDENTS I	II	III	IV	V
1.	The typography of the software	4	4	4	4	3
2.	The reading character on the screen	4	4	4	4	3
3.	The sequences of information on screen	4	5	3	4	4
4.	Consistency of position of message on screen	4	5	3	4	4
5.	Consistency in the use of terms throughout system	4	4	4	3	4
6.	Consistency of the user interface	4	4	3	4	4

7. Conventional assignment of colour codes	4	3	3	4	4
8. Consistency in the display format.	4	3	4	3	4
9. Reasonable data grouping for easy learning	5	4	5	5	5
10 Use of abbreviations and acronyms	4	4	4	4	4
11 Consistency in the use of upper and lower cases	4	4	4	4	3
12 System feedbacks for users	5	4	5	5	5
13 Software attractiveness and easy for use	5	4	5	5	4
14 Flexibility of the users	5	4	5	4	5
15 Organisation of the information of the software	5	3	5	4	4
16 Speed of application	5	4	4	4	4
17 Navigation of main menu	5	3	4	4	4
18 Navigation of Video & diagrams	5	3	4	3	4
19 Simplicity of the software in the use of language, Simulations and Packaging	5	5	4	5	5
20 The interative nature of the package	5	5	4	5	5
Total	**90**	**78**	**80**	**81**	**81**

Average percentage by respondents **82%**

Table 2 showed the views of Computer Experts using scores 5,4,3,2; and 1 as rates given to excellent, very good, good, fair and poor respectively. The minimum rating value was 78% while the highest was 90%. The average percentage of 82% was attained by the five respondents collectively.

Table 3: Responses from Educational Technologists

S/N ITEM	RESPONDENTS				
	I	**II**	**III**	**IV**	**V**
1. The reading character on the screen	4	5	4	4	4
2. Consistency of position of message on screen	4	5	4	4	4
3. Consistency of the user interface	3	5	4	4	5
4, Conventional assignment of colour codes	3	4	4	5	4
5. Consistency in the display format	4	4	4	4	4
6. Consistency in the use of upper and lower cases	-	5	4	4	5
7. System feedback for users	4	5	3	5	4
8. Software attractiveness and easy for use	4	5	4	4	4
9. Flexibility of the software	4	5	4	4	4
10 Speed of application	-	5	4	4	4
11 Navigation of min menu	3	5	4	4	4
12 Navigation of Video & diagrams	4	5	4	4	4
13 Simplicity of the software in the use of language, Simulation Packaging	4	4	4	4	4
14 The interactive nature of the package	4	5	4	4	4
15 Appropriateness of the font type and size	4	5	4	4	4
16 Overall legibility	4	4	4	4	4
17 Clarity of diagrams and figures	4	4	4	4	4
18 Voice audibility	4	5	5	5	5
19 Clarity of accent	4	5	5	5	4
20 Sides layout	4	4	4	5	4
Total	**69**	**94**	**81**	**86**	**83**

Average percentage by respondents **82.6%**

Table 3 showed the views of the educational technologists and graphic designer using scores 5,4,3,2; and 1 as rates given to excellent, very good, good, fair and poor respectively. The minimum rating value was 69% while the highest was 94%. The average percentage of 82.6% was attained by the five respondents collectively.

Table 4: Summary of Responses of Experts in Computer and Educational

Technology Respondents	Computer Experts' view (%)	Educational Technologists view (%)
I	90	69
II	78	94
III	80	81
IV	81	86
V	81	83
Aggregate (%)	**82**	**82.6**

Table 4 showed summary of the analyses of the data collected from educational technologists and computer experts. The computer experts' ranged from 78% to 90% while the educational techologists' minimum rating was 69% while maximum was 94% the aggregate values of both groups of experts which confirmed that Computer – Assisted Instructional Package for Secondary School Physics can be used to teach difficult concepts with rating of 82% and 82.6% respectively.

Research Question Three

What is the difference between physics students taught using CAIPSSP and those taught using conventional method?

Table 5: Performance test results of statistical analysis at (alpha = 0.05 level of significance)

Variable	N	Mean	SD	df
Experimental Group	30	78.2713	8.47357	21.104
Control Group	30	57.400	6.71316	

95% Confidence Interval of the Difference

Table 5 showed a mean score of 78.3% recorded by the experimental group of students exposed to the CAIPSSP while a mean score of 57.4% was recorded by control group not exposed to the CAIPSSP which is basically on conventional method of teaching. 95% Confidence Interval of the Difference was obtained. All values obtained at 0.05 level of significance. These showed that the CAIPSSP has an effect on the students' performance.

Findings

The major finding is that:

1. There are physics concepts in Nigeria Secondary School Curriculum which students find difficult to understand and these have been identified by NERDC and W.A.E.C Chief Examiners' Reports.
2. Computer-Assisted Instructional Package can be effectively designed, developed and assessed for teaching and learning Physics in Ekiti State Secondary Schools.

3. Physic teachers, Computer experts and Educational technologists rated the package as appropriate for teaching difficult Physics concepts in Ekiti State Secondary Schools particularly and Nigeria in general.
4. The student performance post-test statistical analysis showed that there is a significant difference between students exposed to the use of the CAIPSSP and those not exposed to it. The mean score also showed that the experimental group exposed to the use of the CAIPSSP performed better that the control group not exposed to the package.

Conclusions

Computer-assisted instructional package can be designed, developed and assessed to teach not just difficult concepts but all concepts to enhance effective teaching and learning. The various experts consulted for the assessment confirmed this in their rating. This implies that computer has become an invaluable vehicle in delivering instruction at this age of high technological advancement with learners who are easily fascinated by computer technological facilities. This means driving the learners to the unknown through the means they know very well.

Recommendations

In view of the findings of the study, the following recommendations are made:

1. Teachers should identify difficult concepts in their different subject areas and work with educational bodies as NERDC to conduct a fresh research about difficult concept not just in Science and Technological subjects but on all subjects students offer especially at senior secondary schools in Ekiti State and Nigeria at large.
2. In order to enhance interesting qualitative and effective teaching and learning Computer-Assisted Instructional Package should be developed and used to teach not just difficult physics concepts, but difficult concepts in all subjects in Nigeria Secondary Schools.
3. Workshops and seminars should be organized by school administrators and proprietors to assist teacher in Information and Communication Technology (ICT) with special reference to Educational Technology. This to sensitize them of the need to teach the modern learners through modern day technology.
4. Nigeria Educational Research and Development Council (NERDC) should work hand in hand with Nigeria Association for Educational Media and Technology (NAEMT), Science Teachers Association of Nigeria (STAN) and all other educational bodies to make a mass production of CAIP on difficult concepts in all science subjects and practical-oriented subjects in Nigeria secondary schools.

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