Development and Validation of Computer Instructional Package on Physics for Secondary Schools in Nigeria

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ABSTRACT

This study was conducted to develop and validate a computer-assisted instructional (CAI) package on physics for senior secondary school students in Nigeria. Teaching of science subjects in Nigeria is mostly done using traditional method and which was identified as a major cause of students' poor performance in physics. Several researches have indicated (i) Equilibrium of Forces (ii) Simple Harmonic Motion to be some of the topics responsible for students' poor performance in Senior Secondary School Certificate Examinations (SSSCE) in Nigeria. Studies have proven the efficacy of CAI for improving students' performance in all disciplines, developing one for Nigerian physics students is inevitable. The package was developed in an html format using Macromedia Dreamweaver as the overall platform. Other computer programs utilized during the development process are: Microsoft Word, Macromedia Fireworks 8, and Macromedia Flash 8. The package was developed in accordance ADDIE model. The validation was done in four stages: content validation (physics teachers); expert's validation (computer programmers and educational technology specialists); individualized validation (one-on-one validation by students) and cooperative validation (group validation by students). The observations, comments and suggestions during the validation were used to modify the package. At the completion of the package, development and validation was found to produce a very good performance when used for physics instruction.

Keywords: Computer-assisted instruction; Physics; Computer-Supported Cooperative Learning; Secondary School; Nigeria

INTRODUCTION

For any nation to attain the status of self-reliance, science and technology must be an important component of the knowledge to be given to her citizens irrespective of tribe/ethnicity, creed or gender (Ezenwa & Gambari, 2011). Science and technology is incomplete without physics. Physics is one of the science subjects taught at the senior secondary school level of Nigeria educational system. The Federal Republic of Nigeria (FRN, 2004) stated in the national policy of education that physics can be taken as one of the 'cores' among science subjects (i.e. one of biology, chemistry, physics or health science) with other one vocational elective and two non-vocational elective subjects. The study and application of physics is essential to the scientific, industrial, technological and social advancement of societies or nations.

Physics education is aimed at training students to acquire proper understanding of basic principles as well as their applications. It is also aimed at developing in them appropriate scientific skills and attitudes as a pre-requisite for future scientific activities. To achieve these objectives, innovative teaching techniques, active participation and collaborative learning activities become imperative and these would need functioning instructional media to make

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physics instruction effective (Alebiosu & Ifamuyiwa, 2008; Ogunleye, 2000; Onwioduokit, 2000).

In spite of importance of physics as a requirement for many specialized science and technology courses at the university, it is sad to note that students' performance at the secondary school level in the subject is not encouraging (Adesina, 2011; Gambari, 2010) The West African Examinations Council (WAEC) and National Examinations Council (NECO) have repeatedly reported poor performance in physics (NECO, 2011; WAEC, 2012). This problem has major implications on university admission for instance; schools no longer produce adequate number of qualified candidates in science-based courses for university admission. In addition, it prevents the educational system in Nigeria from producing required number of qualified scientists and technologists (Chukwu, 2000; Rafiu & Adetona, 2007). Figure 1 presents a chart on science students' performance at senior secondary school level.

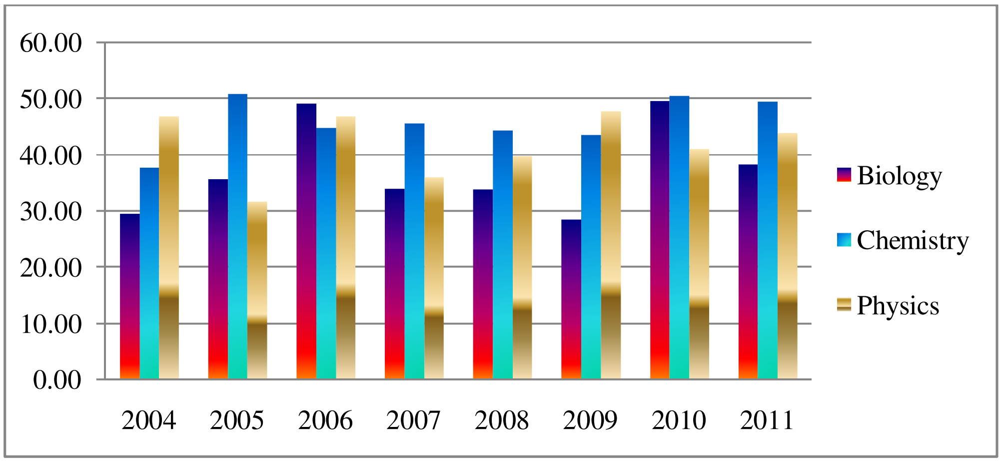

Figure 1. Performance of science students at May/June WASSCE (2004 – 2011)

Figure 1 indicates that the percentage of students that passed physics at credit level had consistently being less than 50% (West African Examination Council [WAEC] Report, 2012). Researchers have identified causes of students' poor performance in science subjects to include poor teaching methods, abstract nature of science concepts, lack of qualified teachers, poor infrastructure and inadequate laboratory facilities, teacher-centred instruction, and non-availability and utilization of instructional materials (Adesina, 2011; Bajah, 2000; Gambari, 2010; Jegede, 2007).

Based on relevant literature from physics experts and West African Examinations Council (WAEC) Chief Examiner's reports on physics, 28 topics were identified as difficult or problematic topics in physics at Senior Secondary School (SSS) level in Nigeria (Bamigbala, 2000; Egwaoje, 1994; Salami, 2003; Okpala & Onocha, 1988). However, Mechanics which is a major branch of physics has the largest number of difficult concepts. More than 30 percent of WAEC physics questions were from mechanics (Rafiu & Adetona, 2006, p.317), The poor performances in physics recorded on the concepts of mechanics are majorly in the area of: elasticity properties of solid, kinetic theory, simple harmonic motion, projectiles motion, relative density of a solid, properties of matter, equilibrium of forces and mechanical energy.

Some innovative teaching strategies have been established to be effective and efficient in promoting and maximizing science learning outcomes. Such strategies include computer-assisted instruction (Tekos & Solomonidou, 2009; Yusuf & Afolabi, 2010), cooperative learning (Hanze & Berger, 2007; Doymus, 2008; Yusuf, Gambari & Olumorin, 2012) among others.

The application of computer technology to classroom environment has a significant role in the present dispensation. Through the use of computer, the roles of many teachers are changing from the traditional lock-step giver of information to that of presenter, manager and facilitator of learning (Hennessy, Deaney, & Ruthven, 2005). According to Oyelekan and Olorundare (2009) there are ample evidences in the literature that establish the potency of the use of the computer in facilitating the teaching and learning of not only difficult concepts. For instance, researchers claim that computer-mediated instruction in comparison to the conventional methods of teaching can enhance the discovery environment (Reid, Zhang, & Chen, 2003), transform learners' alternative conceptions (Jimoyiannis & Komis, 2001) support a collaborative learning (Milrad, 2002), create technological processes (Michael, 2001), enhance understanding of scientific conceptions (Ronen & Eliahu, 2000), provide an interactive 3-dimensional visual stimuli environment (Sung & Ou, 2002), stimulate students' scientific problem solving skills (River & Vockell, 1987), and enhance students' conceptual change (Tao & Gunstone, 1999).

In another development, Kinnaman (1990) reported that students' taught using CAI have more internal locus of control of self-efficacy than conventionally instructed students. Fagbemi, Gambari, Gbodi and Oyedum (2011) reported that CAI is more beneficial to younger students than to older ones. Their findings showed that CAI was beneficial to students in general but the degree of impact decreases from the lower level to higher levels. Bangert-Drowns (1985) reported that CAI is more effective with lower-achieving students than with higher-achieving ones. Again, both lower- and higher-achieving students benefit from CAI. Bayrak (2008), Gbodi and Nwaorgu (2007), Gambari and Mogbo, 2006; Onasanya, Daramola and Asuquo (2006), Nakaka and Okwo (2011), Yusuf & Afolabi, 2010 and other reported that CAI was gender friendly in many areas of disciplines. Hawley, Fletcher, and Piele (1999) and Gambari (2010) noted that the cost differences between CAI and traditional instruction were insignificant. However, researches in these areas are very scanty in Nigeria especially in physics at senior secondary school level.

Though, Computer-Assisted Instruction (CAI) is designed normally for individual learning, but it has been found to be more effective with small groups than individual alone (Fajola, 2000; Gambari, 2010; Yusuf and Afolabi 2010). The use of computer as a medium for collaborative learning is referred to as computer-supported cooperative learning and it has been embraced in developed nations (Hooper, 1992; Hopper, Temiyakan, & Williams, 1993; Johnson, Johnson & Stanne, 1996; Mevarech, 1993; Xin, 1996).

In the early 80s most researches on computer-assisted instruction were based on individualized learning. It was particularly the omission of social interaction in computer-based learning environments which worried many educators (McLoughlin, 2002; Johnson & Johnson, nd; Yu, 2001). However, computer-assisted cooperative setting is one of the most promising ideas to improve teaching and learning with the use of ICT. In computer-supported cooperative settings, working in a group with a computer improved learning and achievement compared to solitary computer work. Also, students working in groups take the initiative to receive comprehensive explanation to difficult questions compared to those working independently at the computer (Hennessy, Deaney, & Ruthven, 2005; Jarveka, Bonk & Lehtinen, 1999; Yu, 2001). Research findings indicate that computer-supported cooperative learning improved students' learning and increases their academic achievement, problem solving skills, and task-related student-student interaction. Students using CAI in cooperative learning settings performed better than students using the same programme individually (Fajola, 2000; Yusuf & Afolabi, 2010).

Based on the above literature, this study focused on the development and validation of computer-assisted instruction for physics secondary school students in Nigeria.

PURPOSE OF THE STUDY

The main purpose of this research was to transform the physics content of the Nigerian secondary school physics curriculum into a computer assisted instructional software, and then package it into a CD-ROM which could be used for teaching and learning of physics at that level. Validation of the software was done to ensure its suitability, and effectiveness in enhancing the teaching and students' learning of physics concepts.

Specifically, this study sought to find out:

1. If the content of the developed Computer Assisted Instructional Package (CAIP) sufficiently and appropriately covered the chosen areas of physics in a sequential manner.
2. Whether the design and development of the CAIP conformed to acceptable standards of computer science and educational technology experts.
3. The performance level of students in physics when taught using the CAIP.

METHODOLOGY

Research Instruments

Development of Computer Assisted Learning Package (CALP)

Computer Assisted Learning Package (CALP) for senior secondary physics used at two different instructional settings (cooperative and individualised) was developed by the researchers and a programmer. The necessity for researcher-made computer package was based on the fact that the commercially produced computer-assisted instructional packages are not common in Nigeria. Even, when available they may not be directly relevant to the topic or objectives to be achieved in a lesson as they may not be culturally relevant to implement physics instruction in Nigeria. The CALP was written in html format using “Macromedia Dreamweaver 8” as the overall platform. Other computer programmes and applications that were also utilized during the development process are Microsoft Word, Macromedia Fireworks 8, and Macromedia Flash 8. Macromedia Fireworks was used for specific texts, graphics and buttons, while Macromedia Flash was used for simulation. The package was validated by computer programmers and educational technology experts; subject content (physics) specialists; and finally field tested on sample representative similar to the students used for the final study. The package contained two topics which were subdivided into sixteen lessons. The main menu of the package consisted of introduction, students' registration, list of lessons as in lesson 1, 2, 3, 4 … 16 and exit. It adopted the drill and practice modes of CAI. The main difference between the group-based programme and the individualised programme were the adjustments made in terms of entries of number of the individuals who reacted to the computer. The production of the package was effected through a team of professionals and specialists including the system programmer, operator and the instructional designers (the researchers). ADDIE instructional model and Dick and Carey (2005) instructional development model were adapted to develop the package.

Development of Test Instrument

The instrument used in collecting data for this study was a researcher-adopted Physics Achievement Test (PAT). The PAT consisted of 100 multiple choice objective items adopted from past examination of West African Examination Council (WAEC, May/June, 1988-2008) and National Examination Council (NECO, June/July, 2000-2007). The Test (PAT) was based on the contents of the CALP. Each of the stems of the PAT had five options (A - E) as possible answers to the question. Students were required to indicate their correct answers by ticking one of the letters (A - D) that corresponds to the correct option in each item. This instrument (PAT) was administered to the experimental and control groups as pre-test and again for the post-test after it had been reshuffled. On the scoring of the multiple-choice items, '1' was awarded for each correct answer and '0' for each wrong answer. Thus, maximum possible score was 100 items. The items were validated by physics teachers, subject officials from external examination body, test and measurement experts. It was tested for reliability using 40 randomly selected SSI students. The test was administered once on the pilot samples. A reliability test using the Kudar Richardson (KR-21) revealed a reliability of 0.90 which was considered adequate for the research study.

Validation of Instrument

The instrument used for field trial validation of the package was a researcher-developed questionnaire. All the items in instrument were constructed to elicit responses from various validators (expert, teachers, computer specialists, educational technology specialists and students) with respect to the use of package. The questionnaire was divided into six parts, namely, content, interactivity, navigation, feedback, screen design and students' preference toward the use of interactive CAI package compared to normal classroom instruction methods of learning. The 4-point Likert scale consisting of 30 questions was used in questionnaire, namely, 1 as Strongly Disagree, 2 as Disagree, 3 as Agree and 4 as Strongly Agree.

Procedure for Validating the Computer Assisted Learning Package (CALP)

The validation of CAI package was done in three stages: (i) experts validation (computer programmers & educational technology experts); (ii) content validation (physics specialists); and (iii) field validation (group and individualistic learners).

Expert Validation

The developed package was given to four computer programmers to determine the appropriateness of the package in terms of language, typography, legibility, navigation, interface, animations, functionality, packaging, and durability. Their suggestions and commendations were used for modifying the package. Similarly, five educational technology experts were requested to validate the package in terms of its suitability for instruction, simplicity, unity among illustrations, emphasis on key concepts, colour use, and text. The experts' comments were used to correct some mistakes while their suggestions were used to improve the package.

Based on the experts' suggestions some text font sizes were increased, some background colours were seen to be distractive were changed; the package was burn on CD instead of flash-drive to avoid distribution of viruses, audio was introduced to the whole contents to signify correct and wrong answers.

Contents Validation

The physics contents of the package was validated by four physics experts from Federal University of Technology Minna and University of Ilorin, two subject officers in Physics unit from NECO, and four physics teachers from four secondary schools in Minna before the package was developed. They were requested to carry out the contents validation of the instrument by ensuring that all items were derived from the content that would be presented to the four groups. The face validity in relation to the background of the students was also

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considered. Subject matter content of the CAI package adequately and sufficiently covered the Nigerian secondary school physics curriculum. After the package was developed, it was validated to determine the appropriateness of the package for teaching the chosen topics; clarity and simplicity of the packages as well as its suitability for the level of the students; the extent to which the contents cover the topics they are meant to cover; possible errors in suggested answers; and the structuring of the package. After the validation, some sentence errors, spelling mistakes, wrong use of subscript and superscript, and misrepresentation of some symbols in the package were corrected. Some paragraphs and formatting errors discovered were also corrected. The test items and contents of the package was later corrected or modified on the basis of suggestions and recommendations of the experts.

Field Trial Validation

This includes individualized and group (cooperative) validation. Senior secondary class II (SSII) students selected for this study based on the following premises:

I. the students had been exposed to the teaching of the SSCE physics syllabus and were not pre-occupied with any major examination;

II. They had been expected to have been exposed to some pre-requisite of physics concepts at SSI level, because certain pre-requisite skills needed to be acquired before the complex ones;

III. SSIII class were not selected because most of the schools' authorities did not allow their final year class to be used for research purposes to avoid interrupting their study schedules which may affect students' performance in the final certificate examinations;

IV. The topics treated for the study (Mechanics) were designed for SSII curriculum;

A purposive random sampling technique was adopted to obtain two secondary schools in Minna, Niger State, Nigeria. These schools were purposively sampled based on equivalence (laboratories, facilities and manpower), school type (public schools), gender composition (mixed schools), ICT equipment (computer laboratories under the School Net programme), exposure (students and teachers exposure to the use of computer in their schools), and candidates' enrolment (enrolling students for SSSCE physics examination for a minimum of ten years).

At the beginning of the study, CAIP was installed on standalone computer systems in the two schools. Students in both groups were exposed to sixteen lessons in the package for six week periods. The sampled students on each school were taught physics using the CAIP for 40 minutes duration per lesson (160 minutes per week). They were allowed to work on the computer terminals in order to ensure the functionality of the package in terms of visual quality, animations, the language structure, the mode of operation and general attitude to the package. The physics contents were presented through the computer and the learners interact and respond to the computer prompts. The computer presents information and display animation to the learner on each of the unit after which the students attempted some multiple-choice questions. The students could only proceed further in a lesson on the condition that the questions were satisfactorily answered. The students must have had at least 100% mastery of one topic before moving on to the next. If after three attempts they do not get the answer correctly, the package immediately logs them out and the instructor had to be called before they could continue through another log-in. The physics teachers assisted by research assistants from each of the four selected schools served as the instructor in the administration of the treatment.

Individualized Group Validation

The CAI package was trial-tested on 18 physics students from Zarumai Model Schools, Minna on individualized learning setting. Each student was placed on stand-alone computer (study alone). The trial test took place immediately after the third term examination before the beginning of the next session to ensure that students' were not taught the concepts before the study. Twenty one students were selected for individualized learning but one of them was absent on the examination day due to ill health. The students in this group were taught how to navigate through the entire package. Individualized Computer Instruction method was used here. The students were taught the concepts using CALP package only. The computer presented the instruction on human-to-computer basis. Students proceeded with the physics contents and study at their own rate. Students answered the PAT test at pre-test and post-test individually.

Cooperative Group Validation

The CAIP was trial tested on 21 students from Mawo schools (n=21) in cooperative learning setting. There were seven groups. Each group comprises of three-members on a computer terminal. Students in cooperative learning group were trained on the use of computer package and, some principles of cooperative learning, social skills, conflict resolution, team work and many others. They were assigned with responsibilities of leader, quite-captain/time keeper and scribe respectively. The cooperative group followed the following instruction sequence to learn the package: (i) group members complete the reading of the materials using CALP package; (ii) Individually, students take a CALP package quiz (answer the questions from computer) on the assigned reading to measure their level of comprehension and to avoid free-riders; (iii) Students take the same quiz as a team attempting to reach consensus with respect to the correct answers for all test questions because only one answer sheet must be submitted by the team for which all teammates receive the same 'team score'; (iv) Each student's individual quiz score and team quiz score are counted equally towards the student's final course grade. (v) High scoring teams is recognized and rewarded in the class.

At the end of this treatment PAT was administered on students to measure the level of mastery the physics concepts using CAIP. The scores obtained by each school in the Physics Achievement Test (PAT) were analysed using the t-test statistics to determine the performance level of the students in physics when taught using CAIP in cooperative and individualized settings. Immediately after PAT, CAIP Validation Scale was administered to measure their responses to the statements in CAIP Validation Questionnaire. The qualitative data obtained from the students was analysed using percentage to measure the evaluation criteria such as sentence complexity; illustrations and demonstrations, how easy or difficult the students learned using the CAIP.

The focus of this study was limited to finding out the performance level of students when taught physics using the CAIP, and not to compare the use of CAIP with any other teaching strategy. The comparative analysis between that use CAIP for cooperative learning and individualized learning was to ensure effective validation from the two groups. Therefore, a test of the difference in achievement between the use of CAIP and any other teaching strategy was considered a subject of further research.

RESULTS

Content Validation

The content validation of the Computer-Assisted Instructional Package (CAIP) in Physics was conducted using Content Validation Questionnaire. Ten specialists in physics which

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include four secondary school physics teachers, four university lecturers in physics and two physics experts from NECO responded to the questionnaire. The result obtained showed strongly agreed with every statement in the questionnaire. However, some minor errors and observation were made which was later corrected. They all agreed that the content of CAI package covered senior secondary school physics year II syllabus. Other statement items of the questionnaire were strongly agreed and agreed respectively. Their comments, observation, and suggestions on the contents were noted and fully implemented. These include typographical errors such as spelling errors, mis-representation of superscripts and subscripts, punctuation marks, etc.

Expert Validation

This includes two experts (computer programmers and educational technologists) which their contributions are immensely appreciated. Four computer programmers were requested to determine the appropriateness of the package in terms of language, typography, legibility, navigation, interface, animations, interactivity, packaging, and durability of the program language used. They rated each of the statement very good and excellent respectively (See Appendices 1, 2, 3 & 4).

Validation by five educational technology experts was based on the following criteria: simplicity, unity among illustrations, emphasis on key concepts, colour use, and text. Each item statement was rated as very good and excellent. However, one of the experts suggested that the audio part should be made flexible in such a way that the user can activate or deactivate the button. One of them suggested that the animation should be hidden to avoid distraction while reading the text. On the basis of the comments and suggestions of the experts, some font types were changed and some were increased, while some background colours were also changed. Other recommendations were fully effected.

Individualized and Group Validation

Eighteen students from individualized group and twenty one students from cooperative group validated the package based on five major criteria: content of the package; interactivity of the package; navigation of the package; feedback from the package; Screen Design of the package; and students' preferences toward the use of the package compared to traditional methods of learning. Students' observations, comments, and suggestions were adequately noted and used to modify the package. Some of their observations include: sentence errors, spelling mistakes, formatting errors, and misrepresentation of symbols in the package. After the students had been taken through the computer package and taught selected sub-topics on physics, the result obtained from their responses as shown on table 1, and analysed accordingly.

Table 1 shows that ninety five percent of the students agreed that the content of the package was suitable for the learning of physics. Students liked the content of this package mainly because it allowed them to move at their own pace and they were able to repeat the same lesson as many times as they wanted. However, four percent disagree with some of the statement items on the contents of the package.

Table 1. Content in the package

S/No	*Statement*	*Response (39 Students)*			
		Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*

1	The messages in the package are easy to understand	28	10	1	0
2	The content of the package has been well organized (arranged in order)	23	13	2	1
3	The diagrams/illustrations in the package are very clear to me.	24	14	1	0
4	The examples used in the various sections of the lessons in the package are relevant.	21	17	1	0
5	It was easy to understand the lesson because information was presented from simple to more difficult one.	18	19	2	0
	Total	*114*	*73*	*7*	*1*

From table 1, the overall total students' response to the statements = 114 + 73 + 7 + 1 = 195.

Total response (Strongly agree) = 114

Percentage response (Strongly agree) = (114 ÷ 195) × 100% = 58.46%

Total response (Agree) = 73

Percentage response (agree) = (73 ÷ 195) × 100% = 37.44%

Total response (Disagree) = 7

Percentage response (Disagree) = (7 ÷ 195) × 100% = 3.59%

Total response (Strongly disagree) = 1

Percentage response (Strongly disagree) = (1 ÷ 195) × 100% = 0.51%

Total positive response (Strongly agree and agree) = 114 + 73 = 187

Percentage positive response (Strongly agree and Agree) = (187 ÷ 195) × 100% = 95.89%.

Total negative response (Disagree and strongly disagree) = 7 + 1 = 8

Percentage negative response (disagree and strongly disagree) = (8 ÷ 195) × 100% = 4.10%.

Table 2. Navigation of the package

S/No	*Statement*	*Response (39 Students)*			
		Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*
1	From the main menu, learners are allowed to register his/her name.	26	14	0	0
2	The exit key enables me to exit from the lesson/programme.	29	8	2	0
3	The PREVIOUS key enables me to revisit the previous section(s) of the lesson.	15	13	0	1
4	The NEXT key directs me to go to the next section of the lesson.	23	15	1	0
5	The OPTION keys allow me to select the correct option.	19	20	0	0
	Total	*111*	*80*	*3*	*1*

From table 2, the overall total students' response to the statements = 111 + 80 + 3 + 1 = 195.

Total response (Strongly agree) = 111

Percentage response (Strongly agree) = (111 ÷ 195) × 100% = 56.92%

Total response (Agree) = 80

Percentage response (Agree) = (80 ÷ 195) × 100% = 41.03%

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Total response (Disagree) = 3

Percentage response (Disagree) = (3 ÷ 195) × 100% = 1.54%

Total response (Strongly disagree) = 1

Percentage response (Strongly disagree) = (1 ÷ 195) × 100% = 0.51%

Total positive response (Strongly agree and Agree) = 111 + 80 = 191

Percentage positive response (Strongly agree and Agree) = (191 ÷ 195) × 100% = 97.95%.

Total negative response (Disagree and strongly disagree) = 3 + 1 = 4

Percentage negative response (disagree and strongly disagree) = (4 ÷ 195) × 100% = 2.05%.

Table 2 shows that ninety seven percent (97%) of the respondents agreed that the navigational assistance of the package was functional. They agreed that the keys for navigating are very effective and make the package users friendly. However, 2% of the respondents held negative opinion.

Table 3. Interactivity of the package

S/No	*Statement*	*Response (39 Students)*			
		Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*
1	It is easy to operate the package with computer keys and icons.	22	16	1	0
2	This package permits me to repeat the section, enlarge animation, and exit the lesson at any time.	13	26	0	0
3	The frequent display of questions to the learners does not interrupt the learning process.	15	21	2	1
4	This package enables me to apply what I have learnt rather than memorize it.	21	15	2	1
5	This package allows me to discover information through active learning.	19	20	0	0
	Total	*90*	*98*	*5*	*2*

From table 3, the overall total students' response to the statements = 90 + 98 + 5 + 2 = 195.

Total response (Strongly agree) = 90

Percentage response (Strongly agree) = (90 ÷ 195) × 100% = 46.15%

Total response (Agree) = 98

Percentage response (Agree) = (98 ÷ 195) × 100% = 50.26%

Total response (Disagree) = 5

Percentage response (Disagree) = (5 ÷ 195) × 100% = 2.56%

Total response (Strongly disagree) = 2

Percentage response (Strongly disagree) = (2 ÷ 195) × 100% = 1.02%

Total positive response (Strongly agree and Agree) = 90 + 98 = 188

Percentage positive response (Strongly agree and Agree) = (188 ÷ 195) × 100% = 96.41%.

Total negative response (Disagree and strongly disagree) = 5 + 2 = 7

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Percentage negative response (disagree and strongly disagree) = (7 ÷ 195) × 100% = 3.59%.

From Table 3, ninety six percent (96%) of the students agreed that this package was interactive mainly because it was designed and developed based on interactivity, user friendliness, dynamic and effective software. They agreed that it make them active during the lesson. Only three and half percent hold contrary opinion.

Table 4. Feedback from the package

S/No	*Statement*	*Response (39 Students)*			
		Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*
1	This package provides immediate feedback after selecting the option.	17	21	0	1
2	This package displays the correct or wrong answer chosen with some sound.	22	17	0	0
3	This package allows me to proceed to the next lesson only if the chosen answer is correct.	28	10	1	0
4	This package terminates my activities if after three attempts I got the answer wrong.	15	24	0	0
5	This package appreciates my efforts by congratulating me after completing the lesson correctly.	33	6	0	0
	Total	*115*	*78*	*1*	*1*

From table 4, the overall total students' response to the statements = 115 + 78 + 1 + 1 = 195.

Total response (Strongly agree) = 115

Percentage response (Strongly agree) = (115 ÷ 195) × 100% = 58.97%

Total response (Agree) = 78

Percentage response (Agree) = (78 ÷ 195) × 100% = 40.00%

Total response (Disagree) = 1

Percentage response (Disagree) = (1 ÷ 195) × 100% = 0.51%

Total response (Strongly disagree) = 1

Percentage response (Strongly disagree) = (1 ÷ 195) × 100% = 0.51%

Total positive response (Strongly agree and Agree) = 115 + 78 = 193

Percentage positive response (Strongly agree and Agree) = (193 ÷ 195) × 100% = 98.97%.

Total negative response (Disagree and strongly disagree) = 1 + 1 = 2

Percentage negative response (disagree and strongly disagree) = (2 ÷ 195) × 100% = 1.03%.

The result from table 4 shows that ninety eight percent (80%) of students agreed that the package provided feedback immediately after a response. The package used drill and practice mode of CAI, failure to answer the question correctly, it will be allowed the students to proceed to the next unit. However, one percent (1%) disagreed with one of the statement item.

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Table 5. Screen design of the package

S/No	Statement	Response (39 Students)			
		Strongly Agree	Agree	Disagree	Strongly Disagree
1	The presentations of the information in the package attract my attention.	13	24	1	1
2	The use of proper lettering (fonts) in terms of style and size make the information legible.	18	19	2	0
3	The colours used for the various presentations are quite appealing.	22	16	1	0
4	The quality of the text, images, graphics and video are interesting.	21	18	0	0
5	The animations (moving picture) in the package assist in understanding the lessons better.	32	7	0	0
	Total	*106*	*84*	*4*	*1*

From table 5, the overall total students' response to the statements = 106 + 84 + 4 + 1 = 195.

Total response (Strongly agree) = 106

Percentage response (Strongly agree) = (106 ÷ 195) × 100% = 54.36%

Total response (Agree) = 84

Percentage response (Agree) = (84 ÷ 195) × 100% = 43.08%

Total response (Disagree) = 4

Percentage response (Disagree) = (4 ÷ 195) × 100% = 2.05%

Total response (Strongly disagree) = 1

Percentage response (Strongly disagree) = (1 ÷ 195) × 100% = 0.51%

Total positive response (Strongly agree and Agree) = 106 + 84 = 190

Percentage positive response (Strongly agree and Agree) = (190 ÷ 195) × 100% = 97.44%.

Total negative response (Disagree and strongly disagree) = 4 + 1 = 5

Percentage negative response (disagree and strongly disagree) = (5 ÷ 195) × 100% = 2.56%.

Results from table 5 shows that ninety seven percent of students agree on the nature of screen design of the package. They also agreed that the presentation of information captivates their attention and stimulate recall. However, 2.5% of the respondents had negative view on the statement items.

Table 6. Students' preferences toward the use of the package compared to traditional methods of learning

S/No	Statement	Response (39 Students)			
		Strongly Agree	Agree	Disagree	Strongly Disagree

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1	I prefer to learn physics with an interactive package with a teacher acting as a facilitator.	28	9	1	0
2	Learning physics with an interactive package is more preferable than using text books.	31	8	0	1
3	The activities provided in this package are more effective compared to normal classroom instruction.	27	11	0	1
4	I will suggest to my friends to use computer package in learning physics instead of textbooks.	25	14	0	0
5	I prefer the use of this instructional method than normal classroom instruction.	29	9	1	0
	Total	*140*	*51*	*2*	*2*

From table 6, the overall total students' response to the statements = 140 + 51 + 2 + 2 = 195.

Total response (Strongly agree) = 140

Percentage response (Strongly agree) = (140 ÷ 195) × 100% = 71.79%

Total response (Agree) = 51

Percentage response (Agree) = (51 ÷ 195) × 100% = 26.15%

Total response (Disagree) = 2

Percentage response (Disagree) = (2 ÷ 195) × 100% = 1.02%

Total response (Strongly disagree) = 2

Percentage response (Strongly disagree) = (2 ÷ 195) × 100% = 1.02%

Total positive response (Strongly agree and Agree) = 140 + 51 = 191

Percentage positive response (Strongly agree and Agree) = (191 ÷ 195) × 100% = 97.95%.

Total negative response (Disagree and strongly disagree) = 2 + 2 = 4

Percentage negative response (disagree and strongly disagree) = (4 ÷ 195) × 100% = 2.051%.

Results from table 6 indicate that ninety seven percent (97%) of students prefer to learn physics with CAI package than using traditional method. Most of them were also willing to suggest the use of CAI package in learning physics to friends, while few of them (2%) held contrary opinion.

The general feelings of the respondents in the field trial validation both for individualized and cooperative group were positive. Most of the respondents were satisfied with the package. The package was found interesting no negative comments or suggestions were made on the package because most of the recommendations made by content and experts validators was been effected.

The CAI package was administered on individualized and cooperative groups using Physics Achievement Test (PAT). The result of PAT is presented in table 7.

Table 7. Students' performance in the PAT

Individualized Group			*Cooperative Group*		
S/No	*Scores*	*Grade*	*S/No*	*Scores*	*Grade*
1	70	A	1	73	A
2	72	A	2	81	A

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3	74	A	3	83	A
4	70	A	4	78	A
5	72	A	5	76	A
6	70	A	6	80	A
7	67	B	7	70	A
8	72	A	8	78	A
9	65	B	9	75	A
10	64	B	10	69	B
11	66	B	11	81	A
12	63	B	12	78	A
13	68	B	13	83	A
14	63	B	14	76	A
15	65	B	15	81	A
16	63	B	16	74	A
17	68	B	17	83	A
18	67	B	18	78	A
			19	72	A
			20	68	B
			21	76	A
Mean Score	*67.16*		*Mean Score*	*76.81*	

The scores from table 7 show that many students in cooperative learning group scored better grade than those in individualized learning group. To make a conclusion about the performance level of students in physics when taught using CAIP, the interpretation of the result was based on the following grading which is commonly used in Nigerian secondary schools.

Below 40% = Very poor
41% - 49% = Poor
50% - 59% = Good
60% - 69% = Very good
70% - 100% = Excellent

The least score of from the groups is 63% the conclusion therefore is that when students were taught equilibrium of forces and simple harmonic motion CAIP, their performance level was very good.

DISCUSSION

The validation reports from content specialist shows that physics lecturers and secondary school teachers who validated the content of CAI package agreed that it covered the concepts of (i) Equilibriums of Forces and, (ii) Simple Harmonic Motion which was based on senior

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secondary school year (SSSII) physics curriculum. They also agreed that the PAT test items covered different levels of understanding based on Bloom's taxonomy of educational objectives (i.e. Knowledge of facts, application of knowledge, and interpretation of concepts). The content specialist agreement to the statement is crucial for the continuation of the package. The content specialist validation was to ensure that the content of the package was carefully prepared. Both the secondary school teachers and university lecturers in physics strongly agreed that the sub-topics treated in the package were sequentially arranged according to the curriculum. It is believed that learning should start from simple to complex; therefore, this sequential arrangement of the sub-topics is considered to be vital to the ease of using the package to teach. The results obtained from content specialist agreed with that of students exposed to the package as individualized and group validators. 94% of the respondents agreed content of the package in respects to the sequencing, illustration, charts, work examples and simplicity of the content. If these had not been properly done, it would probably have created a lot of confusion for the students in learning and affects their performance while testing the package (See table 7). The performance of students in PAT suggests a high degree of validity for the package. It could be deduced that those in cooperative learning obtained high mean scores that those in individualize group. This suggests that CAI could be more effective in cooperative learning than individualized learning. Though, this study is limited to development and validation of CAI only, it did not mean to compare the effectiveness on students' performance.

The professional assessment of computer programmers and educational technology experts was very necessary. Their observations, comments and suggestions contributed to the quality of the package and make adequate impact on the learners. Their validation assessment implies that the CAI package is of international standard.

The findings of this study agree with the finding of Oyelekan and Olorundare (2009) which concluded that Electrolysis Computer Instructional Package (ECIP) improved students' performance.

CONCLUSION

This study has examined physics education and its associated problems especially within the secondary school level in Nigeria. With current status of ICTs in Nigeria, it is the view of the authors that there is still a wide gap to be bridged in the area of CAI for teaching and learning. The use of CAI seems to be the answer. CAI with interactive animation was more effective in teaching the science concepts which seems too abstract while teaching physics concepts. It is hoped that a well developed and adequately validated CAI package of this nature could improve students' performance in physics at Senior Secondary School Certificate Examination (SSSCE). It is therefore recommended that CAI packages should be produced for science and other subjects in the Nigerian secondary school curriculum and this could be achieved with the help of team of experts (teachers, researchers, computer programmers and educational technologists).

RECOMMENDATIONS

Presently, indigenous computer instructional packages on science and other subjects are not readily available in Nigeria. This is due to the fact that the country is still undergoing a process of technological development in the area of ICT. Consequently, the production of instructional package and their corresponding utilization for instruction in our educational system is not widespread. As a result of this, research into the design and development of computer instructional packages, and their utilization for classroom instruction should be

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encouraged. This could be achieved if education stakeholders can supports the schools with ICT infrastructure (computers with internets facilities, LCD projectors, Interactive White Boards, etc), manpower, stable electricity supply, and many others.

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