CONSTRUCTIVIST INSTRUCTIONAL DESIGN: CREATING A MULTIMEDIA PACKAGE FOR TEACHING INTRODUCTORY TECHNOLOGY IN NIGERIAN SECONDARY SCHOOLS

Onasanya, S. A. (Ph.D), Ahmed, M. A. (Ph.D) & Oputa, G. O.
Department of Science Education,
University of Ilorin, P.M.B. 1515, Ilorin, Nigeria
E-mail: bonasanya2003@yahoo.com
Phone No: +234-803-507-1475

Abstract

In this paper, the comparative effect of a researcher-designed ICT presentation on student's introductory technology in junior secondary school in Kwara State Nigeria was investigated. Two hypotheses were postulated and tested at 0.05 level of significant difference. From the analysis, the following findings were reached: (i) there was a significance difference between the achievement scores of introductory technology students taught with the ICT software and those taught with the conventional method on the posttest ($t=15.54 df=38, p \leq 0.05$). This shows that ICT method is a better approach to embark upon by introductory technology teachers for meaningful teaching than traditional lecture method. (ii) There was no significant difference between the mean achievement score of male and female students taught with ICT (computer) learning software ($t=0.29$, $df=19$, $p \geq 0.05$). This implies that the ICT software stimulated male and female students alike. The implications of the findings for the use of ICT software were discussed. Recommendations for the improvement of introductory technology education in Nigeria and suggestions for further studies were also postulated

Keywords: Computer Aided learning; Introductory Technology Achievement Tech ITAT Software; Individualized Instrument; ICT instructional software; Junior Secondary Students; Kwara State.

Introduction

Multimedia is a subset of the wider issue of the use of ICT (Information and Communication Technology) in schools. While there is widespread recognition that people need to learn how to use computers effectively in order to function in modern society, there is debate about the nature of that learning. Some see it as a simple but lengthy list of technical skills while others see it as also including recognition of the power of ICT to bring about a major change in learning. Avarim and Talmi (2004) identify several groups active in ICT in education, including Technocrats, who see the use of ICT as non-problematic and simply a matter of using the new tools, and Reformists, who see ICT as a major and possibly inexorable agent of change in education.

The reformist group see the rapid growth in the use of ICT in schooling occurring in conjunction with the adoption of the constructivist learning theory.(OECD, 2001). This theory supports active, hands-on learning. It is related to Cognitive Apprenticeship and the work of Jerome Bruner.

Some educators see ICT as being a major driver of school reform. This reform is towards a more constructivist approach, using related terms such as: student-centred learning, problem-based learning and experiential education. Others point to the slow pace of such reform and suggest that ICT may support reform but it is by no means inevitable that it will do so. (eLearning europa, 2005)

The present study is based upon the background supported by previous researchers who see ICT as a powerful tool for constructivist learning point to its capacity to provide:

(i) Active and highly motivating engagement with students
(ii) Powerful tools to create text, art, music, sound, models, presentations, movies etc. that produce high quality products and remove much of the tedium normally associated with such creation
(iii) An error-forgiving environment in which editing of a product fosters learning by trial and error
(iv) Easy communication in text, voice, video
(v) Quick access to information and resources (Avarim and Talmi 2004; OECD 2001; eLearning europa, 2005)

Educators are finding, however, that while ICT can provide a technical environment for constructivist learning to occur, there needs to be high quality teaching to develop and sustain an environment that will challenge and inspire students to learn. (Avarim and Talmi 2004)

One of the problems of teaching and learning is the method of imparting knowledge to learners. According to Stone (1991), the major difficulty in sciences is the method by which the subjects are customarily taught without regards to instructional materials. The pedagogical approach in imparting knowledge to learners has become inadequate to their needs. Bajah (1995) and Okeke (1986) found that science subjects has not been taught in Nigeria schools the way pupils benefits most, as science instruments has mostly been teacher –centered. For the past two decades, science education has been facing a lot of difficulties which include poor performance of students in science subjects (Adeyegbe, 1992). Introductory technology, like other science subjects, recorded poor students' performance both in national and international examination (Akale, 1986). Many factors contributed to the poor performance of students in introductory technology examination (Akale, 1986, Okebukola and Jegede (1986). These factors include:

(i) Inability of the teachers to put across the concepts to the students
(ii) Lack of skills and competence required for teaching
(iii) Shortage of qualified introductory technology teachers
(iv) Lack of teaching materials and necessary equipment

Introductory technology as a subject is very important for the scientific and technological advancement of any nation. Though its usefulness cuts across all fields of human endeavor, the low enrolment of students in the subject at both secondary and post secondary levels has been a source of concern to various people especially introductory technology educators at various times (Omosewo, 1999; Balogun, 1985; Ogunneye, 1982; Orisaseyi, 1977; Ogunyemi and Eboda, 1974).

Lack of active participation of students is one of the factors responsible for students' poor performances in West African Examination Council (WEAC) results of secondary schools where students' performances are generally poor in introductory technology, physics, chemistry, biology and other sciences –related subjects (WEAC, 2000). This pattern of poor performance in the sciences by students is also observed in tertiary institutions (Olarinoye, 1987). Omosewo (1999:99), asserted that.

> *Teachers were using the lecture method of teaching the subject in the secondary schools. The direct impact of this method on learners is that it often leads to lack of understanding and this might cause poor performance and low enrolment of students in the subject. The low enrolment in introductory technology is a cog in the wheel of the scientific and technological progress in this nation*.

Many of the students see science as too abstract to comprehend, thereby resorting to memorization or rote of learning. Many students have also changed from science subjects to art and commercial subjects while some dropped out and some failed woefully at the final examination. Meanwhile, various attempts have been by government, school proprietors and teachers to facilitate effective teaching and learning of these science courses, which are the rudiments of development of any nation. Textbooks have been constantly reviewed and rewritten in simpler forms and teaching aids of various types designed, yet the problems persist.

Ogunleye (2000) found out that in the era of technological advancement, technology has had minimum impact on education. This is because 80% of teachers in Nigeria are mostly using the chalkboard and textbook method (traditional method) in teaching. Actually, most schools do not have modern equipment and materials. The few schools that have this equipment are unable to use them effectively as a result of erratic electric power supply and at times the inability of some teachers to operate some of this equipment. However, constant use of the traditional method of teaching is a major factor contributing to poor academic achievement introductory technology students.

One of the major problems faced by students is inability to remember what has been learnt. This problem is often caused by too much theoretical expression by the teachers while learners are passive listeners. Students memorize and regurgitate facts and concepts.

The above problems confronting the teaching and learning of introductory technology can be handled using slide presentations, video presentation process, and other interactive ICT software facilities in which a student interacts with and is guided by visual equipment of study aimed at achieving certain instructional goals (Eke, 1988, Ezeliora, 1987, and Onasanya, 2002).

Computer can be used to transform classroom instruction into a series of rich memorable experiences and thus reduce boredom and forgetfulness for teaching subjects including introductory technology. In the recent years, the use of this equipment in the process of teaching and learning has become widespread in educational institutions with the development of microcomputer (Ezeliora, 1997; Onasanya, 2002).

Abimbade (1996) reported that the use of computer (i) increases the time of learners devote to learning , (ii) Enhance the speed of availability of data and information, (iii) Provide immediate feed-back (iv) Assist less qualified teachers and (v) Increase teachers efficiently and effectiveness.

Udousoro and Abimbade (1997) and Adeniyi (1997) pointed out that students taught mathematics and physics with visual aid achieved higher cognitively than those taught without computer.

This study was carried out to determine the effect of ICT on introductory technology and its implication on student's performance. It was to address the problem of consistence poor performance of students in junior secondary schools and tertiary levels. The purpose of the study was to compare the effect of ICT presentation and the traditional method of teaching (chalk-and -talk method) in teaching and learning introductory technology in secondary schools in Kwara State, Nigeria.

Materials and Method

Research Hypotheses

The following null hypotheses were formulated and tested at $p \leq 0.05$ so as to obtain answers to the research questions:

(i) There is no significant difference between the mean achievement scores of students taught introductory technology with ICT presentation and those taught without the ICT (Verbal presentation).

(ii) There is no significant difference between the mean achievement scores of male and female students taught introductory technology with the ICT presentations.

Research Design

The research design was a pretest – posttest experimental control group design carried out in some junior secondary schools in Kwara State. The study used two groups of randomized pretest and posttest design.

Sample and Population

The population for this study was made up of all junior secondary class three students in two Local Government Areas in Ilorin East Local Government Areas of Kwara State. The sample subjects were drawn from two co-educational and two single gender schools in Ilorin East Local Government Areas of Kwara State. The subjects from the co-educational schools were selected by the use of stratified random sampling technique. This method was chosen so that the gender variable could be appropriately represented.

Research Design

The researcher used an experimental research approach. Therefore, the pretest and posttest control group design was used for the study. Twenty (20) students offering introductory technology were randomly selected for the study from each of four secondary schools. In all, there were forty (40) males and forty (40) females. The students were taught the same concepts in introductory technology using the conventional method and the ICT learning software.

Instrumentation

The test instrument was made up of 50 items of the Introductory Technology Achievement Test (ITAT) which was used as pretest and posttest to measure both the lower and higher cognitive skills of the students in introductory technology. The test items required multiple-choice objective questions with five options (A-E) as possible answers to the questions which the students answered before and after the experiment. The experimental group was exposed to introductory technology lesson using ICT method for period of six weeks while the control group was taught the same introductory technology using the conventional traditional method.

After the duration of six weeks of treatment for the experimental group and the six week of lecture method for the control group, the posttest (ITAT) was administered to both groups at the same tradition in the usual per-pencil method.

The treatment instrument which was interactive ICT learning software was developed by the researcher using the subject contents drawn from the secondary school syllabus. The program was written in Visual Basics, Fire Works, CorelDraw and Microsoft Word. The topics treated were selected based on junior secondary school the syllabus. The topic selected was from first term scheme of work and falls between the periods that research was carried out.

The development of courseware for this research material follows the systematic and recursive approach of instructional development model put forth by Mervill and Goodman (1972); Philips (1987); and Dick and Carey (1996).However, five trails were made before the packages become successful. It was then tested with some few selected secondary schools in Ilorin, Kwara State. These schools used for testing the package falls between the population of the study but not

part of the schools selected for research study. Some of the complaints from these selected students about the packages was later used for further modification and finally perfected the package.

Validity and Reliability of the Instruments

The ICT presentation (introductory technology package less) items were pilot tested and found to satisfy face, content and construct validity by three experts in educational technology, science education departments. Item analysis of the instrument was also carried out to determine the facility and discrimination indices after which the final items for the instrument were selected and the reliability coefficient computer using the split-half approach and the Richard Kuderson formula 21 (KR-2). The value obtained for the reliability coefficient was 0.95 and this was considered to be adequate for this study.

Method of Data Analysis

The mean, standard deviation and the t-test statistical analysis scores of the different groups were computed and used in testing the hypothesis. The level of the significance adopted for the analysis was $p \leq 0.05$. This level of significance formed the basis for rejecting or not rejecting each of the hypotheses.

Results

Two research questions were raised in this study and two null hypotheses were formulated and tested to provide answers to the research questions. Analyses of the pretest and posttest data collected by means of the introductory technology were used to answer the research questions using the two null hypotheses as guide. Means, standard deviations and the t-test were employed in analysing the pretest and posttest data.

The level of significance adopted for the analysis is 0.05. This level of significance formed the basis for rejecting or not rejecting a null hypothesis. The summary of the data analysis and results is presented below.

A pretest was administered to both the experimental and control groups. The test was the 50-item multiple-choice introductory technology. The subjects were allowed forty minutes to do the test. The test was given to determine the academic equivalent of the experimental and control groups.

The mean scores of students in the experimental and control groups on the pretest were calculated and the t-test computed for the two means. Table 2 shows the means, standard deviations and the result of the t-test analysis.

Table 2: t-test comparison of the mean scores of experimental and control groups on the pretest

Variable	N	df	Mean	SD	t.value Calculated	t-value Critical	p-value	Remark
Experimental Group	40	38	13.84	2.86				
Control Group	40		13.65	3.09	*0.22	2.08	0.83	Not Significant

* Not significant at 0.05

The result in Table 2 indicates that there is no significant difference at 0.05 level of significance between the pretest mean scores of the experimental and control groups ($t = 0.22$, $df = 38$, $p > 0.05$). This means that the subjects in the experimental and control groups were at the same entry level with regards to academic ability before the introductory technology topics were presented to them. Their mean scores were statistically the same.

Hypothesis 1
There is no significant difference between the mean scores of students taught introductory technology with ICT presentation and those taught using the conventional method of presentation.

To test this hypothesis, the posttest means scores of the experimental and control groups were presented and compared using the t-test statistics. The result is shown in Table 3.

Table 3: t-test comparison of the posttest mean scores of the experimental and control groups

Variable	N	df	X	SD	t-table Calculated	t-value critical	P-value	Remark
Experimental Group	40	38	64.66	5.82	15.54*	4.75	0.001	Significant
Control Group	40		49.63	4.79				

*Significant at p≤ 0.05

The result (of the t-test analyses) in Table 3 shows that there was significant difference between the posttest mean scores of the experimental and control groups at 0.05 level of significant (t= 15.54, df = 38, p <0.05). Hypothesis I was therefore not accepted. This means that there was a significant difference at 0.05 level of significance between the performances of students taught with the ICT presentation and those taught conventionally. Students taught with the computer package performed better than those who were taught without computer; hence, the ICT software enhanced the learning of introductory technology.

Hypothesis 2
There is no significance difference between the mean achievement scores of male and female students taught introductory technology with the Computer-Aided learning software.

To test this hypothesis, the posttest mean scores of male and female students in the experimental group were computed. The analysis was carried out using the t-test statistics and the result shown in table 4.

Table 4: t-test showing the posttest performance of male and female students in the experimental group

Variable	N	df	X	SD	t-value Calculated	t-value critical	P	Remark
Males	20	19	62.26	6.23	0.29*	2.07	0.757	Not Significant
Females	20		63.73	5.78				

* Not Significant at p≤ 0.05

From the result in Table 4, it can be seen that there was no significant difference between the posttest mean scores of male and female physics students in the experimental group at 0.05

level of significance ($t=0.29$, $df=19$, $p>0.05$). Null hypothesis 2 was therefore not rejected. The performances of the male and female students in the experimental group were equally enhanced by the use of the ICT software, hence the Computer software on introductory technology was gender friendly.

Discussion

Finding on Table 3 indicates that there was a significant difference in the introductory technology achievement of students taught with the Computer –Aided learning software. Those students taught with the computer software performed better in the introductory technology achievement test compared with those who were taught using the conventional method. The result seem to agree with earlier studies which concluded that students taught mathematics and Physics with computer achieved higher cognitively than those taught without computer (Udousoro and Abimbade, 1997); Adeniyi, 1997); Hassan, 1997) and Jonah, 1991) James and Barbara (2002) asserted that CAL promotes intrinsic motivation for graduate students to learn better, therefore be seen as a tool for effective teaching and learning of introductory technology subjects. ICT is an effective tool that can efficiently and effectively develop individual's cognitive structure, psychomotor and affective abilities.

Findings on Table 4 indicated that there was no significant difference between the performances of male and female students who were taught introductory technology software. The male and female students performed equally well. The result agrees with the findings of Abdullahi (1982) who found that gender did not influence students' performance in science generally.

Conclusion

From the findings of this research work, the following conclusions were drawn:

(i) Instructional strategies that teachers employ in teaching science subjects at secondary school level have significant effects on students' achievement. The findings of the present study showed that better performance in introductory technology can be achieved through the use of ICT software package.

(ii) Male and female students were affected positively and equally by the use of ICT software package in teaching introductory technology. This showed that the ICT is not gender dependent.

Recommendations

From the findings of the present study, the following recommendations are made.

1. The use of ICT, CAI for teaching and learning in our schools should be encourages. Therefore, computer instructions should be made compulsory for teachers and students in all levels of our educational systems.
2. Curriculum planners should enforce/inoculate the use of ICT and computer education/training into school curricula.
3. Educators should continue to lay more emphasis and implement the concepts of educational technology as a means of enhancing the quality of education.
4. Federal Government should fully implement ICT literacy at all levels of education in Nigeria.
5. In-service training should be given to teachers on educational technology particular on the production and use of computerized instructional materials.
6. There is need for government and non-governmental organizations to organize seminars, workshops, conferences as well as in-service training for teachers on methodology of teaching so as to be able to compare and contrast effects of different methods of teaching on students' achievement.
7. Schools should be equipped with computer and Internet facilities and other necessary instructional packages like slide and video presentations.

8. Science teachers should learn how to prepare lesson notes and instructional packages using the ICT method of presentations.
9. Emphasis should be placed on making learning to be a learner-centered affairs as well as teaching for meaningful learning.
10. The role differentiation amongst boys and girls should be avoided when teaching science and technology. Each gender deserves equity in exposure to educational experience.
11. Academic cooperation, though not to the point of replication or subjugation should be worked out by departments of introductory technology/computer science and educational Technology to develop adequate software for effective learning.

References

Abdullahi, A. (1981). A study of factors with interest in science career*. Journal of Research in Curriculum (JORIC), 6 (1), 69-76.*

Abimbade, A. (1996). *Principles and practice of educational technology*. Ibadan: International Publishers Ltd.

Adeniyi, A. (1997). *Computer aided instruction and achievement in physics: Innovation in science,technology and mathematics*. STAN Proceeding of Ajumogobia Memorial Conference, pp257-260.

Adeyegbe, S. O. (1992). *Assessing students' work in chemistry*: The WAEC state of the art. A paper Delivered at STAN Chemistry Workshop for Chemistry Teachers, A.B.U, Kano Campus, 10-15 April.

Akale, M.A.G. (1986). *Assessment of students achievement in science: What implications for teachers training.* Proceeding of the 27th Annual Conference of the Science Teacher Association of Nigeria (STAN).

Aviram, R. & Talmi, D. (2004). *Are you a technocrat a reformist or a holist?* eLearning Europa, http://www.elearningeuropa.info/index.php?page=doc&doc_id=4965&doclng=6&menuzone=1

Bajah, S. T. (1995). *Practical skills in science and technology.* A Key Note Address Delivered at the 36th Annual Conference of STAN, Maiduguri, 14th –19th August.

Balogun, T.A. (1985). Interest in service and technology education in Nigeria. *Journal of the Science Teachers Association of Nigeria (STAN), (1&2), 92-99.*

E-learning Europa (2005). *A new paradigm for school education.* http://elearningeuropa.info/index.php?page=doc&doc_id=5947&doclng=6&menuzone=1

Ezeliora, B. (1997). *Computer: A new technology in chemistry teaching and learning: innovation in science, technology and mathematics.* STAN proceeding of Ajumogobia Memorial College, pp257-260.

Hassan, Z . M. (1997). *An export system for teaching mathematics and physics*. Unpublished B. Tech. Project, Mathematics/Computer Science Department, Federal University of Technology, Minna.

James, P. & Barbara, P. (2002). *A web enabled graduate course: Two perspectives: Technology tools for use in the classroom.* Proceeding of the Seventh Annual Mid-South Instructional Technology Conference, Middle Tennessee State University. April 7-9, 2002.

Jonah, A. O. (1991*). Use of computer to aid effective teaching of mathematics in secondary school.* Unpublished B. Tech. Project, Mathematics/Computer science Department, Federal University Of Technology, Minna.

Mervill, M. A. & Goodman, R. I. (1972). *Selecting instructional strategies and media:* A place to being in. U.S.A. national special media institute.

OECD (2001). *Learning to change.* Recovered from http://www.oecdbookshop.org/

Ogunleye, A. O. (2000). *Towards the optimal utilization and management of resources for the effective teaching and learning of physics in schools.* In O.O. Busari (Ed),41st Annual Conference Proceeding, Journal of STAN.

Ogunneye, W. (1982). The relative effect of selected instructional styles on student achievement in physics. *Journal of (STAN), 21(1), 97-101.*

Ogunyemi, E. O. & Eboda, F. M. (1974). Cognitive preferences among high and low physics achievers in two nigeria secondary schools*. African Journal of Education Researches, 1(1), 107-133.*

Okebukola, A. O. & Jegede, O. J. (1986). *The under achieving student in science. opinions on the etiology of ailment.* Proceeding of the 27th Annual Conference of the STAN. Pp. 57-63.

Okeke, E. A. (1986). *Remedies for student poor performance in biology*. Proceeding of the 27th Annual Conference of Science Teacher Association of Nigeria.

Olarinoye, R. D. (1987). The inquiry and discovery method of teaching science. *Journal of STAN, 21 (1), 168-180.*

Omosewo, E. O. (1999). Impact and discovery method of teaching on students' achievement in physics*. Journal of Nigerian Association of Teachers of Technology* (JONATT), 3(1), 99-107.

Orisaseyi, S. (1977). A critical look at the attitude of secondary schools students to physics. *Journal of STAN, 16 (1), 49-55.*

Philip, B. (1987*). Author languages for computer aided learning*: London. Macmillian Education Ltd.

Udousoro, U. J. & Abimbade, A. (1997). *The place of computer assisted instruction in mathematics.* STAN Proceeding of Ajumogobia Memorial Conference. Pp.238-243.

West African Examination Council (WAEC) (2000). *Examinations report in science subjects*. Lagos: WAEC