THE EFFECT OF COMPUTER-ASSISTED INSTRUCTION SOFTWARE ON INDIVIDUALIZED INSTRUCTION OF PHYSICS IN SECONDARY SCHOOLS: IMPLICATION FOR COUNSELLING

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Abstract
The effect of Computer-Assisted Instruction software on physics achievement in senior secondary schools in Niger State, Nigeria was investigated. Causes of poor performance in physics accordance to gender disparity were discussed. One hypothesis was postulated and tested at 0.05 level of significance. The results indicated that, there was no significant difference between the mean achievement scores of male and female physics students taught with the Computer-Assisted Instruction software ($t = 0.31$, $df = 19$, $p \geq 0.05$). This shows that the CAI software stimulated males and females alike. The counseling implications of the findings for the use of CAI software were discussed. Recommendations for the use of computer to reduce gender disparity were made.

KEYWORDS: Computer-Assisted Instruction (CAI); CAI software; Gender; Individualized Instruction; Physics; Achievement; Counseling, Senior Secondary Students

Introduction

Education is that process which helps to develop the whole man physically, mentally, morally, politically, socially and technologically to enable him function in an environment which he may find himself (FRN, 1985). And for women, as a special group, education gives them a better chance to control their lives. It equips them to earn money, be better mothers and to have improved relationship with their spouses. According to UNICEF, over 130 million children of school age in the developing world are growing up without access to basic education, of whom nearly two of three are female (UNICEF, 1998). If lucky or privileged enough to attend school, a number of studies have shown females are far less likely to enroll in science, mathematics, computer science and engineering courses (cf. ethics.cwru.edu/ecsel/abstracts/women.html; http://www.becta.uk/info-sheets/gender.html; http://www.nsf.gov/sbe/srs/seind96/chl_cont.htm).

Abdulrahman (1991) pointed out that the economic, social and political development of the country depends largely on the extent of the ability of the nation to mobilize its womenfolk through effective education. In Nigeria, the concept of women as irrational human beings and who are also physically and mentally weak has been a major reason why women have not been able to contribute their fullest to national development. This misconception also causes the low rate of enrolment of girls compared to boys at all levels of education and places the former at a serious disadvantage. Alele-Williams (1989) remarked that what Nigerian women need in order to contribute meaningfully to national development is effective education, the type that would help them discover themselves, utilize their potentials and get well-equipped for self-reliance. In view of the above points, girls should not shy away from science subjects, rather many of them should be encouraged to study physics, engineering, computer science, medicine and the like.

The examination of the gender conflict by Oke (2000) reveals that though there has been gender conflict from the time immemorial, yet there is no indication of gender supremacy in educational attainment, religious and national development among the female and male fold. William (1992) and Eloko (1996) have submitted that both genders are equal and have vital role to play in every organization and society in every effort to achieve coexistence. Mallum (2001) posits that the research into gender conflict in educational attainment has indicated that there is no significant disequilibrium between the masculine and feminine performance.

Computer education is a very important part of education today. Although, not everyone needs to program, everyone needs to have a basic understanding of computers to participate adequately as a citizen (Clarke, 2002). Several studies investigating gender differences in the use of computers revealed that males tend to be more interested in computers than females. Spender (2002) reported that women are as absent from the electronic media and the computer world today, as they were from print media when it was introduced five centuries ago. Watts (2001), stated that gender differences in time taken to learn computer related tasks favoured girls over the boys, because at younger age, boys prefer using computers when doing simulations. He (Watts) further explained that girls uses computers less and develop a more negative attitude towards computers as they advance through school. But boys on the other hand, spend more of their leisure time (including their lunch time) in computer related activities. In another study conducted by Becker (1998), they found that girls enjoyed technology significantly less than boys at each point in time. Girls perceived the computer to be more difficult than boys throughout the study. They also viewed computers to be a less effective instructional tool.

El-khawas (2000) had identified four areas of concern regarding gender differences. Learning styles, software, computer curriculum and even classroom layout, contribute to disparities between genders and the effectiveness of information technology. Females tend to identify with computers interactively and conversationally, while males see computers as tools and as something to be mastered. Computer software (educational software inclusive) often contains themes of competition, aggressiveness, and loud noise, which have characteristics that tend to appeal more to males than females.

The American Association of University Women (AAUW), pointed out that one of the reasons for gender differences in the use of computers in educational institutions is that, girls are treated not only differently in the classrooms environment a bit unfairly as well. They cited many examples such as; teachers wait longer for boys to answer questions than for girls. Some teachers give more encouragement to boys than to girls. Boys are called upon (by teachers) more than girls. Challenging questions are more posed to boys than to girls.

Women roles in socio-economic development and environment seems to be culturally determined in traditional societies, hence, females potentials are seriously constrained and taken for granted (Morenikeji, 2000). This has resulted in females being subjected to considerable societal, industrial, occupational and environmental segregation. Females are particularly concentrated in semi and unskilled employment in retailing, clothing industry, catering and cleaning. Women are mostly employed to do lower grade jobs in clerical and secretarial posts, while the relatively small portion of professional women employees are concentrated in the caring profession such as education, welfare and health (Morenikeji, 2000).

The Federal Office of Statistics (1996) in Morenikeji (2000) reported that one of the causes of the low status accorded women in several societies is the discrimination against them in educational environment. World Trade Organization (1998) reported that, there is a great disparity in male- female school enrolment in favour of males. This view is also

supported by a five years (1997-2001) enrolment analysis of Day Secondary School Bosso, Minna, for Senior School Certificate Examination (SSCE) which is presented in Table 1.

Table 1: SSCE Enrolment Analysis of D.S.S. Bosso (1997-2001)

Year	Candidates	Males	Females
1997	579	384(66.32%)	195(33.68%)
1998	528	300(56.82%)	228(43.18%)
1999	754	426(56.50%)	328(43.50%)
2000	839	506(60.30%)	333(39.70%)
2001	714	418(58.54%)	296(41.46%)

Source; Niger State Secondary Education Board, Minna

The percentage enrolment in Table 1 shows that the percentage of males is tremendously higher than that of females. This result is not much different from other secondary schools in Niger State. This disparity in school enrolment (in favour of males) may be attributed to the desire of some parents to educate the male child, rather than educate the female child. This is because some parents believe that the male children have better employment opportunities than the female children (World Trade Organization, 1998). Many researches in Nigeria and world over (Hartley & Bostrom, 1982; Jegede & Inyang, 1989; Becker 1998) have shown much interest in the study of the relationship between gender and differential effectiveness of schooling. Their findings are in line with the reports of World Trade Organization (1998) as they all agree that males are more in the school than females. They further observed that female participation both in science and education in general have to declined drastically. Lagoke (1992) opined that the factors responsible for this declination includes: early maturation, early marriage of the females, which lead to their removal from schools, particularly in the northern Nigeria. He (Lagoke) reported that both the attendance rate and the quality of female education differ from region to region. More girls attend school in south-western part of Nigeria, although the rate is still lower than that of males. Tobin (1988) and Lagoke (1992) reported that male students respond to teachers' questions by raising their hands, and also manipulates equipments to a greater extent than female students in classroom and laboratory activities.

Choisse (1991) observed that professionally, there are very few women in science and technology and this is mostly due to socio-cultural and environmental variables such as parents and social expectations, the attitudes of teachers towards girls, peer group attitudes, task, role assignment, starting from childhood and the consequent female inferiority complex and submissive attitudes developed by girls themselves. Some factors that tend to contribute to their state of affairs are the interaction which the male students have with their teachers and the preferential attention given to males by their teachers. Many teachers are not disturbed when girls contribute less to classroom discussion, because females are expected to be quiet. Therefore, more attention is paid to boys than girls by their teachers in the classroom environment.

However, Shuaib and Ameh (1982) observed that, female students performed better in integrative processes than their male counterparts. Also, James and Barbara (2002) in his study noted that female students perform better with the use of inquiry method, than their male counterparts. Omolara, (1999) observed that, considerable body of evidence has been established to show that girls are more interested and motivated to study, if they learn something, and know its usefulness and social application. It is therefore, necessary to device ways of teaching and counseling girls, to motivate them` sufficiently to learn.

Teachers' method of teaching was identified as a major factor affecting classroom instruction. Ogunleye (2000) opined that teachers' method of teaching hinders understanding.

Balogun (1985); Okebukola (1985) and Ajewole (1997) stated that teachers still use traditional method of teaching mainly, which lead to poor students' understanding and performance. They noted that this method of teaching (traditional) does not aid meaningful learning. Many attempts have been made by government, schools and teachers to improve students understanding. Lawal (2000) reported that other teaching methods like: simulation and games, laboratory discovery, puzzles etc have been tried, but students performance continue to decline. Curriculum, and textbooks have been written and reviewed, yet students still record poor performance in physics and biology.

Okebukola (1992) outlined, various teaching methods which researchers have found to be effective in promoting students performance to include; concept –mapping, analogy, co-operative learning, problem solving, role modeling and Computer-Assisted Instruction which is a method that is currently gaining research attention worldwide, and has been used in developed countries to facilitate meaningful development and tackle most instructional problems. Computer aids learning and makes the understanding of abstract subjects easier. (Lawal, 2000). Optimal learning through individualised instruction takes place with the use of computer. (Ezeliora, 1997). The purpose of this study is to find out if there is any significant difference in the performance of male and female students taught physics by means of the CAI software package developed by the researchers. It is in view of these, that the researcher saw the need to seek ways of improving physics instruction by using a developed Computer-Assisted Instruction software package for individualised physics instruction in Niger State secondary schools.

Statement of the Problem

The purpose of this study was to investigate the impact of an enabling school environment on the use of CAI towards gender discrimination on physics and biology achievement test in Senior Secondary school in Minna, Niger State.

The Research Objectives

The objectives of this research are to develop a Computer-Assisted Instruction software package for individualized physics instruction in selected Niger State Senior Secondary schools with a view to:

(i) Encourage the provision of a good learning environment to reduce educational problems.
(ii) Improve students understanding and performance in physics
(iii) Arouse and maintain students' interest in the study of physics.
(iv) Improve on the enrolment figures of female students in the study of physics.

Research Question

The study specifically sought answers to the research question:

(i) Is there any difference in the performances of male and female secondary school students taught physics with the CAI software?

Research Hypothesis

The null hypothesis was formulated and tested at $p \leq 0.05$ so as to obtain answer to the research question:

Ho_1 There is no significant difference between the mean achievement scores of male and female physics students taught with the Computer-Assisted Instruction software.

Research Design

The research design was a pretest-posttest experimental control group design carried out in some secondary schools in Niger State. The study used two groups of randomised pretest and posttest design.

Sample and population

The population for this study was made up of all the senior secondary class one (SSI) students in two Local Government Areas in Niger State. The sample subjects were drawn from two co-educational and two single gender schools in Bosso and Shiroro Local Government Areas of Niger State. The respondents 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.

Twenty (20) science students were randomly selected for the study from each of the four schools. In all there were forty (40) males and forty (40) females. The students were taught the same concept of physics using traditional chalk-and-talk method with the Computer-Assisted Instruction software.

Instrumentation

The research instrument was made up of 50 items of the Physics Achievement Test (PAT) which was used as pretest and posttest to measure both the lower and higher cognitive skills of the students in physics. The test items required multiple-choice objective question with five options (A-E) as possible answers to the question which the students answered before and after the experiment. The experimental group was exposed to physics lesson using Computer-Assisted Instruction software for the period of six weeks while the control group were taught the same physics lesson with the traditional chalk-and-talk method.

After the duration of six weeks of treatment for the experimental group and six week of lecture method with control group. The posttest, PAT was administered to both groups at the same duration in the usual paper per-pencil method.

Validity and Reliability of the Instruments

The Computer-Assisted Instruction (physics package lesson) and the PAT test items were pilot tested and found to satisfy face, content and construct validity by three experts in educational technology, physics and computer science 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 computed using the split-half approach and the Richard Kuderson formula (KR–20). The value obtained for the reliability coefficient was 0.97 and this was considered to be quite 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 and Discussion

Two Research questions were raised in this study and two null hypotheses were formulated and tested to provide answers to the research questions. Analysis of the pretest and posttest data collected by means of the physics achievement test (PAT) 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 analyses and results are presented in Table 2 and 3.

Performance of Experimental and Control Groups on the Pretest

A pretest was administered to both the experimental and control groups. The test was the 50-item multiple-choice physics objective test (PAT). The students were allowed forty minutes to do the test. The test was given to determine the academic equivalence 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	$\overline{X}$	SD	df	t-value calculated	t-value critical	P	Remark
Experimental Group	20	14.43	2.91	19	0.24^{ns}	2.09	0.81	Not significant
Control Group	20	14.35	3.13					

ns - Not significant at $p \leq 0.05$

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 ($t = 0.24$, $df = 19$, $p > 0.05$). This means that students in the experimental and control groups were at the same entry level with regard to academic ability before the physics topics were presented to them. Their mean scores were statistically the same.

Performance of Male and Female Students in the Experimental Group on the Posttest

Hypothesis 1: There is no significant difference between the mean achievement scores of male and female physics students taught with the Computer-Assisted Instruction 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 statistic and the result shown in Table 3.

Table 3: t–test Comparison of the Posttest Mean Scores of Male and Female Physics Students in the Experimental Group

Variable	N	$\overline{X}$	SD	df	t-value calculated	t-value critical	P	Remark
Males	20	68.70	6.37	19	0.31^{ns}	2.09	0.757	Not Significant
Females	20	69.20	5.75					

ns - Not Significant at $p \leq 0.05$

From the result in Table 3, 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 ($t = 0.31$, $df = 19$, $p > 0.05$). Null hypothesis 2 was therefore not rejected. The performances of the male and female physics students in the

experimental group were equally enhanced by the use of the computer physics software. Hence the CAI physics software was gender friendly.

Discussion

Findings on Table 3 indicate that there was no significant difference between the performances of male and female students who were taught physics with the computer software. The male and female students performed equally well. The result agrees with the findings of William (1992); Eloko (1996); Oke (2000); Mallum (2001) who found that gender did not influence students' performance in science generally. The research findings is contrary to the findings of Watts (2001) who found that, there is gender differences in time taken to learn computer related tasks favoured girls over the boys. Also, it disagree with the findings of Shaibu and Ameh (1982) and James and Barbara (1991) who observed that females students performed better in integrative processes and with the use of inquiry method than their male counterparts.

Implication for Counselling

Computer-Assisted Instruction from the result of this study makes it clear that the learning of abstract physics concepts to be easy, interesting, and improves students understanding which eventually lead to improved performance. CAI has been used world wide to facilitate meaningful development and resolve institutional problems. This scenario makes it clear that students and their teachers need cognitive restructuring counselling at various levels: the individual student's level, at the students peer relatives level, at the school community level and the societal levels. Cognitive restructuring counselling at these levels will make a formidable network of individuals, peer groups, pan-ethic and other associations who will understand, accept and support Computer-Assisted Instruction that will enable student to access quality physics education nationally and internationally. Cognitive counselling, Ellis (1962) will make all stake holders to think rationally concerning enabling the schools and homes to buy computers for home and school use so that students can have access to computers at home and at school. Any former ideas about physics and negative "mindsets" values and attitudes towards the learning of physics can be changed through cognitive structuring counselling.

Also, the stakeholders would need sensitisation counselling. They need to be sensitive to the fact, that the world has gone for computer literacy. Any nation that does not embrace the idea, might be left behind. Workshops, seminars, summits and conferences can also be used to alert the society of the need to also use computer for physics instruction and not only the traditional "talk and chalk" method of instruction.

Conclusion

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

(i) Instructional strategies that teachers employ in teaching science subjects at senior secondary school level have significant effects on students' achievement. The findings of the present study showed that better performance in physics can be achieved through the use of CAI software, hence students would need sensitisation counselling on the use of CAI software..

(ii) The male and female students were affected positively and equally by the use of CAI software in teaching physics. This showed that the effect of CAL software is not gender dependent, hence teachers need to be counseled to avoid the stereotype placed on females concerning their ability to achieve in science subjects.

Recommendations

From the findings of the present study, the following recommendations were made:

1. The use of computer for teaching and learning in secondary schools should be encouraged. Therefore, computer education should be made compulsory for teachers and students in all secondary schools.
2. Curriculum planners should include the use of computer in teaching and learning into the secondary school curricula.
3. Educators should continue to lay more emphasis on the use of the concepts of educational technology for enhancing the quality of education in secondary schools.
4. Federal Government should fully implement the computer literacy policy formulated in 1988, particularly in secondary schools
5. In–service training should be given to teachers on Educational Technology particularly on the production and use of computerised instructional media, so that they can appropriate the use of modern instructional technology.
6. Schools should be equipped with computers and Internet facilities and other necessary instructional packages for teaching and learning in secondary schools.
7. Science teachers in secondary schools should learn how to prepare Computer-Assisted Instructional software.
8. Emphasis should be placed on making science learning to be a learner-centred affair.
9. There should be adequate counsel on gender role differentiation amongst boys and girls. This should be avoided particularly when teaching science. Each gender deserves equity in exposure to any science educational experience.

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