Effects of Computer Assisted Instruction in Integrated Science: A focus on Distance Education Students in Ghana.

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Abstract

The study investigated the effects of computer-assisted instruction in integrated scienceon Distance Education students in Greater Accra, Western, Brong Ahafo and Ashanti Regions in Ghana. Two research questions and two hypotheses were formulated for the study. The design adopted for the study was quasi-experimental. One hundred and two (102) Distance Education students were selected for the study. Students from four regions and selected study centres were selected in greater Accra, western, BrongAhafo and Ashanti Region and were used as research sample. The experimental group was exposed to computer-assisted instruction package in integrated sciencewhile the control group was taught the same topics with the Lecture method. The data were analysed using the Analysis of Variance (ANOVA). The hypotheses were tested at 0.05

level of significance. The findings of the study showed that students taught integrated sciencewith computer-assisted instruction package in integrated scienceperformed better than those taught with conventional teaching method and gender had an effect on their integrated scienceachievement scores. It was recommended that integrated scienceteachers should continuously use computer packages in teaching as it guarantees an improvement in students' achievement in the subject.

Keywords

Computer Assisted Instruction, Lecture Method, integratedscience, Achievement.

INTRODUCTION

Integrated scienceis one of the important courses taught inthe distance education curriculum. It is a central subject to many science related courses such as medicine, pharmacy, agriculture, nursing, biochemistry(Kareem, 2003). It is obvious thatstudents intending to study these disciplines cannot do without integrated sciencesince it serves as a pivot in science related courses. This has attractedthe attention of researchers and curriculum planners towards researching into integrated scienceas a subject which is of very great importance globally (Kareem, 2003). In spite of the importance and popularity of integrated scienceamong Ghanaian students, performance has been poor in the tertiary level (Ahmed, 2008). For some time now, it has been the desire of researchers to ascertain the causes of the poor performance in integrated scienceamongst distance education students. It has been observed that poor performance in integrated Sciences is caused by the poor quality of integrated scienceteachers, overcrowded classrooms and lack of suitable and inadequate science equipment, among others (Abdullahi, 1982; Bajah, 1979; Kareem, 2003; Ogunniyi, 1979). Students are not able to perform well in integrated sciencebecause of large class size and inadequateresources. The laboratories are ill-equipped and the integrated sciencesyllabus is veryloaded (Ahmed, 2008; Ajayi, 1998) making it difficult to complete syllabuses. The potential

benefits of Computer Assisted Instruction (CAI) cannot be underestimated in this contemporary world because the global world is being driven by technology. Different CAI packages on different subjects have emerged and have been adopted to improve teaching and learning processes. It is crystal clear that the current trend in research all over the world is the use of computer facilities and resources to enhance students' learning. This may be the reason why Handelsman, Ebert-May, Beichner, Bruns, Chang, et al (2004) opined that "many exercises that depart from traditional method are now readily accessible on the web" (p. 521), even though teachers do not use these facilities. They further posited that the interactive approach from using Computer Assisted Instructioncompared to lecturing significantly enhances the teaching learning process. In a review of empirical studies on CAI, Cotton (1997) concluded, among others, that the use of CAI as a supplement to traditional way of delivering instruction produces higher achievement than the use of traditional method of instructional delivery and ongoing research is inconclusive regarding the comparative effectiveness of traditional mode of instruction alone and CAI alone, and that computer-based education (CAI and other computer applications) produce higher achievement than the traditional mode of instruction alone(Kareem, 2003. In addition, students learn instructional contents faster with CAI than with traditional mode alone, they retain what they have learned better with CAI than with traditional mode of instruction alone and CAI activities appear to be at least as cost effective (Mill,2001). Furthermore, computer assisted instruction has been found to enhance students' performance than the conventional instructional method (Karper, Robinson, & Casado-Kehoe, 2005). Mill (2001) in his findings revealed that CAI was found to be as effective as classroom for fact-based learning, but not as effective for topics requiring critical thinking or mathematical problem solving. In addition, the time required by learners to use CAI was higher than traditional classroom instruction. Students taught using traditional instruction combined with the use of computer performed significantly better than students taught using traditional instruction in a college setting (Akour, 2006). Similarly, college students taught

statistics using lecture-plus-CAI obtained higher averages on midterm and final exams than students taught using lecture method only (Basturk, 2005). Based on a review of several studies and shortcoming on studies comparing CAI with traditional mode of instruction, CAI can be considered as effective as traditional instructionsetting (Akour, 2006). Furthermore, how CAI is delivered can affect its effectiveness, and that new studies are needed to clarify the effect of CAI in contemporary student environments (Jenk& Springer, 2002)

In the Ghanaiancurriculum, integrated sciencehas played an important role, among many other things, since there is no other subject which is more effective than integrated science(Thube&Shaligram, 2007). Today, more than ever, science depends on the fields of knowledge to solve problems and to state theories and predict results (Alhassan, 2012). Springer, (2002) recently reported that little of our life is affected by the scientific product, often enough in fundamental and far-reaching ways. You realize that we are in a "global universe," when you think about technological and communicating infrastructure, which is the basis for our lives (AECT, 1977). The importance accorded to integrated sciencein the curriculum reflected precisely recognition of its essential role in contemporary society. integration science is one of the mandatory subjects in the education curriculum. Research shows that students in integrated scienceand education have little academic achievement. Also, distance students complain about the difficulty of Integrated science. integrated sciencehas thus culminated in poor distance education academic achievements. The results of students at the Distance University for 5 consecutive years are shown in Table 1. The records are in particular the results published between 2008 and 2012 in integrated science at the College of Distance Education.

Table 1: Percentage of Candidates that passed integrated science

Year	Total Enrolled	Candidate % of Candidates with Credit and above
2008	1,191,40	40.15
2009	1,297,70	39.71
2010	1,454,47	42.17
2011	1,667,05	43.26
2012	1,775,78	40.46

Average % Pass 51.55

Source: ***Chief examiners Report,*** **2012**

Table 1 shows that the average percentage increases of 51.5 results in 2008-2012 are not encouraging, as it is less than the average. Usman (2002) recalled from his experiences with the identification of integrated sciencethat it is sufficient for anyone to worry about the state of the art today. According to him, many candidates submit their response scripts with nothing written. Some just recopy questions, whereas a large proportion of all who tried to write receive low or failure ratings. Thomas (2001) also claimed that there is a low level of engagement in the study of integrated scienceat all levels of education that integrated scienceis disgusting or hateful to students.

Many research findings have produced useful results in every standard of education on the effects of the poor academic performance of students in science. For example, the two main classes of such problems according to Thomas (2001) are pedagogical and psychological. In pedagogical cases, he pinpointed such factors as poorly qualified integrated scienceteachers, insufficient instructional materials for integratedscience

teaching and continuous use of lecture methods throughout all levels in schools. Tekbiyik, KonurPirasa (2008) argued that the factors accountable for the poor performance of the students in the integrated scienceprogram on distance learning are the unsuitable implementation of student techniques. The Chief Examiner also observes that the difficulty hampering the achievement of integratedscience is attributed to the teacher's approach to conveying curriculum content to students (WAEC, 2008).

Many integratedscience educators have persisted in their quest for an alternate solution and more suitable methods of teaching integratedscience (Yusuf & Afolabi, 2010). Investigative efforts have shown that integratedscience teachers in the education and learning of integratedscience have significant challenges and too many theoretical expressions (Yusuf & Afolabi, 2010). Davidson (2010) reports that even in countries such as India, China, Japan, etc., there are significant difficulties in learning integrated science. In their respective studies, Afolabim and Akinbobola (2009) examined CAI on the performance of integratedscience students, where the experimental group was instructed using CAI while the control group was taught using the lecture method. The results showed that the experimental group performed much better after treatment than those of the control group. Perhaps the exploration of new techniques that can bring real-life knowledge to their doorsteps may be a particular development that can probably encourage students (Bakac, Kartal-Tasoglu&Akbay, 2011). Bakac et al., (2011) argued that the computer is currently used in a very versatile manner to support a broad range of subjects, particularly integrated scienceand technology topics. Many types of research have been carried out on the effectiveness of Computer Assisted Instruction (CAI) (Basturk, 2005) which showed that CAI-trained students performed better than those trained by traditional teaching strategy such as the lecture method. Meanwhile, other researchers (Bakac et al., 2011) affirmed the impact of CAI on academic achievement is small or no for students.

Research in integratedscience into gender-related issues is incomplete. Achuonye (2011) found a significant difference in the academic achievement of males and females students taught using CAI in favour of male students (Yusuf & Afolabi, 2010; Basturk, 2005) gender did not affect the performance of students exposed to CAI in both males, and females. With regard to the discussion above, the aim of this study was to determine the effects of CAI on the integrated scienceachievement of students on the Distance Education Programme (DEP), to determine the impact of CAI on student performance in particular in integratedscience in Ghana

Statement of the Problem

In spite of the importance attached to the subject in national education policy, several studies have shown poor academic achievements in integratedscience especially by Distance Education students in Ghana (Odili, 2006). Year after year, student's performance continues to worsen. According to Odili, 2006,all stakeholders in distance learning have become concerned about this because no lecturer or tutorteaching integratedscience on the distance program in Ghana can demonstrate that everything works well in the subject matter. Those who teach subjects that need integratedscience have complained about the challenges they face, such as their lack of interest in the subject. In addition, integratedscience education still follows traditional patterns like the lecture method of reading and so on, which were considered ineffective in ensuring the active involvement of students (Odili, 2006).

This study examined the effects of Computer Assisted Instruction (CAI) on integratedscience performance on Distance Education students.

Objectives of the Study

The following were the research objectives for this study

1. To develop an instructional package in integrated science
2. To find out the effects of Computer Assisted Instruction (CAI) on the integrated science achievement of Distance Education Students.
3. To examine whether there is any difference in integrated science achievement of male and female distance students taught using CAI

Research Questions

The study provided answers to the following research questions

1. What are the differences in the academic achievement of students taught integrated science using computer-assisted instruction and those taught with lecture teaching method?
2. Is there any difference in the academic achievement of males and females' students in distance education taught integrated science using computer-assisted instruction and those taught with the lecture teaching methods?

Null Hypotheses

The following two Null hypotheses were tested at 0.05 significant level

HO1: There is no significant difference between the academic achievement of distance students taught integratedscience using computer-assisted instruction package and those taught with the conventional teaching method.

HO2: There is no significant difference between the academic achievement of males and females on the distance program taught integrated science using computer-assisted instruction package and those taught with lecture method.

Scope of the Study

This study utilized a developed CAI package and found its impact in certain selected integrated science constructs on student achievement in distance learning. The study was carried out in four distance centres with special involvement of level 200 students. It also examines the impact of gender on the performance of students when taught using the package of the CAI.

Related Literature

This study's theoretical framework is supported by behavioural and cognitive theories. operational conditioning, a form of behavioural theory, is one of the most important theories used in many computer studies. operant Conditioning is a kind of learning where an individual achieves a certain result by producing an action called an operant. If something pleasant follows the operator, the result will be reinforced negatively. In computer-aided learning, the behaviour is reinforced by the right response to the next step when the correct answer is given (Salahudeen, 2012).

Tabassum (2004) The reinforcement theory of Skinner is essential for computerized learning; in particular drills and practical work and tutorials. Owusu et al., (2010) also claimed that computer-assisted instruction is mainly backed by the behavioural perspective of learning because of the concept of practice and reinforcement, particularly in tutorial mode. Cognitive theorists, on the other hand, recognize that much learning involves contiguity and repetition-built associations. They also recognized the importance of reinforcing, although they highlighted its role in giving feedback as a motivator on the correctness of the answers. Furst (1958) was of the opinion that cognitive theorists considered the learning of cognitive structures, through the discovery or reorganization of human information, to be learning. Cognitivism is linked to this study because it acknowledges the place of background knowledge in which content can

be chosen, practiced and organized in a careful way from simple to complex lesson material.

Methodology

The study used a quasi-experimental design; a pre-test, post-test non-equivalent group design which entails the use of non-randomized group where the researcher cannot randomly sample and assign subjects because intact classes were used to administer the treatment. Without disrupting the study centre settings,four distinct intact classes were used, two for the experimental group and two for the control group.

Population and Sample

In all level, 200 students of (26) study centres were randomly selected from four regions in Ghana with a total population of two thousand two hundred and fifteen (2215). It is from this population that one hundred and two (102) students were selected, consisting of sixty-four (64) male and thirty-nine (39) female. The sample distribution by gender and study centre is presented in Table 2 below.

Table 2: Distribution of Sample by Gender and Schools

S/N	NAME OF REGION	POPULATION	FEMALE	MALE
1	Ashanti	130	10	16
2	Central	83	11	14
3	Western	77	10	18
4	BrongAhafo	129	9	15
TOTAL	4	419	40	62

source: field study, 2019

Instruments

Two instruments, the Distance Education Achievement Test (UAT) and Computer Assisted Instruction Package (CAIP) were developed by the researchers with the assistance of a professional Programme developer were used for the study. The (UAT) and CAIP were validated by a team of experts from the University of Cape Coast. 45 (UAT) submitted for validation were modified on the basis of suggestions and recommendations of the validators. The final forty (40) (UAT) items were used for the study. The reliability coefficient for the (UAT) was found to be 0.80 after using the test-retest method. The tests were conducted with the help of research assistants to 102 students. For testing of hypotheses, the collected data was used. In order to test the two null hypotheses, F-test statistics were used.

Table 3: Results of ANOVA Test for Experimental and Control Group on Pre-test

Source of variation	Sum of squares	Dr	Mean Square	Fcal	Sig Level
Between groups	0.1	1	0.101	0.0021	0.980
Within groups	12347.876	200	61.676		
Total	12337.886	201			

Not significant at 0.05

Table 3 indicates that there is no significant difference in integrated science achievement by students from the experimental group and students from the control group because calculated 0.990 significant level is greater than 0.05 standard alpha level ($p>0.05$). This means that the students in the two groups exhibited approximately the same entry behaviour before the treatment. **Hypotheses one (HO1):** There is no significant

difference between the academic achievement of Students taught integrated science using computer-assisted instruction and those taught with lecture method.

Table4: Results of ANOVA Test for Experimental and Control Group on Post-test

Source of variation	Sum of squares	Dr	Mean Square	Fcal	Sig Level
Between groups	054589.767	1	54589.767	552.304	0.000
Within groups	19768.000	200	98.840		
Total	74357.67	201			

***Significant at 0.05 level**

Table 4 indicates that there is a significant difference between the achievement scores in integratedscience students from the Experimental Group and students from the Control Group because 0.000 significant level is less than 0.05 alpha level ($p<0.05$). Therefore, hypothesis one is rejected. This means, there is a significant difference in the academic achievement of students taught using Computer Assisted Instruction Package and those taught with lecture method. The significant difference in favour of students taught using CAI.

Hypotheses HO2: There is no significant difference between the academic achievement of males and females 'studentstaught integratedscience using computer-assisted instruction package and those taught with lecture method.

Table5: Results of ANOVA Test on gender

Source of variation	Sum of squares	Dr	Mean Square	Fcal	Sig Level
Between groups	64517.424	3	21505.808	540.076	0.000
Within groups	7645.392	I92	39.820		
Total	72162.816	195			

***Significant at 0.05 level**

From Table 5 all the four test groups were compared on post-test in terms of differences in integratedscience achievement scores by Gender. The result indicates that there is significant difference between the scores of males and females students of the tested groups because 0.000 significant level is less than 0.05 alpha level of significance ($p<0.05$) Since the ANOVA indicates that there is significant difference among the four groups in Table 5, there is the need to find out which group(s) is responsible for the difference using Ducan post hoc test

Table 6: Duncan Post Hoc Test on Comparison of Achievement Scores by Gender

Test Code	N	Subset for alpha = 0.05				
		1	2			
Female exp grp	39	57.3846				
Male exp grp	59			76.1864		

Source: field study, 2019

Table 6 indicates the mean scores of experimental groups. So, the mean Scores obtained from the male group was significantly higher than the female group (76.19 > 57.39). It is to be noted that a significant difference is in favour of the male gender.

Summary of Findings

The following are a summary of the research findings:

1. Students taught integratedscience with the use of computer-assisted instruction package performed better than those taught mathematics with the lecture teaching method.
2. The performance of students in integratedscience when they are taught with computer assisted instruction is gender dependent. The study indicates that there is a statistically significant difference in the integratedscience scores in favour of male students.

From Table 3, the results of Analysis of Variance (ANOVA) on the achievement of integratedscience students through computer-assisted training shows that there is no significant difference among pre-test performance of the experimental and control groups. This indicated a corresponding integratedscience background as entry behaviour for students in two groups. However, the findings showed that the academic achievement of students who were taught with a computer aid and those who were taught with a lecture method are significantly different. In other words, the differences between students who are taught with CAI are significant. This outcome is consistent with earlier work of Tabassum (2004) who concluded that students using CAI were far higher than students using the traditional approach in integratedscience concepts and computation. This shows that students taught by CAI have performed better on the integratedscience concepts than those students taught with lecture methods.

The findings of Harrison in Owusu (2009) on computer-assisted instruction in integratedscience concepts also validated the outcomes of this study. The result shows

that students receiving computer assisted instructions are more successful than students receiving traditional instructions. The study shows that CAI can improve the performance of students. The findings of this study also verified the findings of Gönen, Kocakaya&İnan (2006) who demonstrated that when they investigated a comparative study to evaluate the efficacy of computer-assisted teaching versus computer science students ' computer classroom lecture, CAI showed that the classroom lecture was far higher than that for knowledge, analysis, and synthesis of Bloom's taxonomy. In terms of assessment and application skills, CAI has demonstrated great efficiency in increasing these skills compared to classroom lectures. This study indicates that CAI can improve the performance of students.

The results of this study are however opposed to the findings of Imhanlahimi and Imhanlahimi (2008) which have reported no major difference in final exam results between CAI students and traditional teachers. However, Owusu's (2009) finding on comparative modes of instruction with CAI modes showed that CAI is not as useful as previously believed since the students in the CAI group performed less effectively than those in traditional modes of instruction. In contrast to Owusu (2009), the use of CAI was shown to be highly effective, since CAI has proven to be inefficient.

The ducan test used as post hoc as the observation indicated that a significant difference exists in favour of male students between male and female students exposed to CAI. This finding is consistent with the finding of (Jenks, 2012) who noted that there is a significant difference between males and females' students exposed to CAI. Huynh *et al.,* (2005) found that there are no statistically significant outcomes invalidating the differences between male and female students in the pattern of online interaction. Also, Yusuf and Afolabi (2010) Bello cited in Achuonye (2011) argued that students exposed to CAI were not affected by gender. The results showed, however, that male and female were not better at the CAI level compared with female genres based on the findings of this study.

Conclusion

Based on the findings of this study it was concluded that;

Computer-assisted instruction has significantly enhanced student achievement, given that those students who have been taught with CAI performed far better than those who have been taught using conventional teaching methods, and also that there are statistical differences in the integrated scientific achievement rates between males and females in favour of CAI. Computer Assisted Instruction affects students 'knowledge levelspositively. Increasing the CAI opportunities in the classrooms will increase the academic achievement of students. There is the need to educate all educational stake holders about the properties of CAI to enable them harness the benefits that come with their use for teachingand learning in distance education. Further studies should be undertaken to explore CAI critical success factors and teachers' attitude about CAI adoption at the teacher training colleges.

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