EFFECTS OF COMPUTER-SUPPORTED LEARNING ENVIRONMENT ON STUDENTS' LEARNING OUTCOMES IN SECONDARY SCHOOL CHEMISTRY

ODUTUYI M. O. Ph.D
Department of Special Education and Curriculum Studies,
Adeyemi College of Education, Ondo,
Ondo State, Nigeria

Abstract
The study investigated the effects of computer-supported learning environment on students' learning outcomes in Secondary School Chemistry. Specifically, the study determined the effects of Computer-supported Cooperative Instruction (CCI), Computer-supported Individualistic Instruction(CII) and Conventional Teacher Expository Method (CTEM) on students' performance and retention ability in Chemistry. The study adopted the pre-test, post-test control group quasi-experimental research design. The sample comprised 149 Senior Secondary 1II (SSIII) Chemistry students in their intact classes from three schools purposively selected from three Local Government Areas (LGAs) of Ondo State. Three research instruments were used for collection of data, namely; Computer-Assisted Learning Package on Chemistry (CALPC), Scholastic Ability Test in Chemistry (SATC) and Chemistry Achievement Test (CAT). Data collected were analysed using Analysis of Covariance (ANCOVA). The results of the analysis showed that there was a significant difference in the performance and retention ability of Chemistry students exposed to CCI, CII and CTEM. Both the CCI and CII improved the performance and retention ability of the learners. The CCI was found to be most effective in enhancing better performance and retention ability of the learners. Based on the findings, it was recommended that computer-supported cooperative instruction should be encouraged for teaching and learning of Chemistry

Key words: *Computer-Supported learning environment, Cooperative learning, Retention*

Introduction

In recent times, the world has witnessed a rapid increase in technological innovations which heralded the advent of the computer system among other modern technologies. The computer is continually gaining ground in many spheres of human endeavours. Today, the Computer Technology in schools is one of the most far reaching and fast growing development on science. The computer technology has permeated nearly all aspects of human organizational roles and education. It is the recognition of this fact, that led the Federal Government of Nigeria to incorporate Computer Education in the curricular at all levels of our educational system. The use of computer in the classroom has given rise to Computer-Assisted Instruction software packages for classroom instructional purposes. According to Umaru (2003), Computer Assisted Instruction is a programme of instruction or package presented as computer software for instructional purpose. The incursion of the electronic computer into the education scene, according to Sherman (2005) cited in Bada, Adewole and Oladokun (2009) provides the wherewithal to solve teaching and learning problems even more rapidly and accurately than hitherto conceived. The computer has also been found to be effective device for classroom instruction using different softwares (Gambari & Mogbo, 2006; Yusuf and Afolabi, 2010).

Fafunwa (1991) asserted that in order for new teachers of Africa to be effective in their jobs, they would need to adapt themselves to the rapid changes that will occur during their teaching career. Developments in science and technology have brought into lime light the indispensable roles of computer in teaching and learning. It is also a new instructional strategy. The use of the computer will help to attract students' interest to the teaching and learning situation thereby providing computer-aided education and computer proficiency skills to the learners.

Computer-Aided Instruction (CAI) is designed normally for individual learning, but it has been found to be more effective with cooperative learning than individualized instruction (Johnson and Johnson 2008). The use of the computer as a medium for cooperative learning is referred to as computer supported cooperative learning and it has been embraced in developed nations (Johnson & Stanne, 1996; Johnson & Johnson, 2008).

The computer may be used individually or in groups in a cooperative learning environment ,where students can discuss the concept as it is learned. The often perceived difficult and abstract concepts in Chemistry such as radioactivity, mole concept, stoichiometry, electrochemistry, organic Chemistry and so on can be encoded or programmed and presented in an exciting and captivating inter-phase that is simply a beauty to behold (Oloruntegbe & Odutuyi, 2008). Chemistry teachers could develop programmes on topics in Chemistry and make them available for students to use on their own. The use of computers has made

graphic presentation possible, which enable students to understand abstract concepts better than traditional blackboard drawings.

CAI could be used in effective teaching and learning of most of the concepts and principles in the Chemistry curriculum. Teachers should review the computer programme to understand the context of the lessons and determine which ones fit the needs of their students and how they can enhance instruction.

Chemistry Education as a discipline is a wholesome subject that is applicable in all facets of human endeavours, be it at home, in agriculture, health and industry. It is a core science subject and as such a credit pass in it is required before a student can be admitted in any tertiary institution for most science-related disciplines like Medicine, Pharmacy, Biochemistry, Microbiology, Agriculture, metallurgy and all the fields of Engineering. The study of Chemistry entails the learning of concepts, established principles, laws and theories and also substantial activity-oriented laboratory work. These laboratory experiments are to demonstrate practically some of the principles taught in theory, test the validity of certain empirical chemical laws and illustrate properties of substances taught theoretically in the classroom. CAI could be used in Chemistry practical classes for analyzing data, as well as solving chemical calculations involving complex equations.

Despite the potentials embedded in learning Chemistry and its importance to mankind and the efforts of researchers to improve the quality of its teaching and learning especially at the Secondary School level, the performance of students in the subject in recent times is disappointing. The percentage of candidates that passed Chemistry at credit level has consistently been less than 50 percent for the past ten years (West African Examinations Council (WAEC) Report, 2011). Therefore, there is need for an innovative teaching and learning strategies which involve the use of Information and Communication Technology (ICT) based approach to the teaching and learning of Chemistry. The instructional method employed by the teachers plays an important role in the acquisition of skills and meaningful learning. Therefore, for effective teaching and learning to take place, teachers must be skillful in the selection and utilization of appropriate teaching strategies.

Several teaching strategies have been designed and used to improve the teaching and learning of science , ranging from teacher-centred techniques to other learner-centred methods. All these strategies gave a little improvement over the conventional lecture method, which is being used in our Secondary Schools. However, there seems to be a neglect of other important innovative teaching strategies such as the application of computer-support instruction in the teaching and learning situation.

In Cooperative learning instructional strategy, there is a common goal and the achievement of the group determines the success of individual members. If the

group does not succeed, individuals cannot succeed. Cooperative learning is a teaching strategy in which small teams, each with students of different levels of ability use a variety of learning activities to improve their understanding of a subject. Each member of a team is expected not only to learn what is taught, but also helps team mates to learn, thus, creating an atmosphere of achievement. In a cooperative learning setting, students work together to attain group goals instead of working individually or competitively. Students discuss subject matters, help each other to learn and provide encouragement for members of the group. The participation of every student in the group and cooperation among group members is considered important. Students are rewarded for their individual and collective efforts. There are many cooperative learning strategies that are designed to achieve different objectives. Out of the several cooperative learning strategies, the following six strategies have received attention and have been well researched and found to be effective in enhancing students' learning: Learning Together (LT); Group Investigation (GI); Jigsaw Procedure (JP); Students Teams Achievement Divisions (STAD); Team Assisted Instruction/Individualization (TAI); and Cooperative Integrated Reading and Composition (CIRC) (Johnson & Johnson, 1994; Gambari, 2010).

In individualistic interaction pattern, there is no correlation among the goal attainments of the participants (Johnson & Johnson, 1987). Whether an individual accomplishes his or her goal has no effect on whether other participants achieve their goals. The learning or achievement of one student is independent and separate from the achievements of the other students in the class. Each student works alone based on his or her ability using a variety of instructional activities to improve his/her understanding of the concepts being taught. Each student works alone and is not expected to be interrupted by other students. Learning resources and materials need to be organized so that each student has immediate access to the appropriate materials.

The review of some research studies by a number of researchers on the effectiveness of computer supported collaborative learning environments on students' learning outcomes shows contradictory reports. Olatoye, Aderogba and Aanu (2011) reported that both cooperative and individualised methods significantly improved students' achievement in Organic Chemistry but cooperative method is significantly better than individualized method. The efficacy of both teaching strategies also has nothing to do with students' gender and self-concept. Aluko (2008) was also of the opinion that cooperative instructional strategy was more effective in enhancing better performance of the learners in Chemistry. Okebukola and Ogunniyi (1984) opined that the cooperative arrangement was better for promoting achievement while the competitive arrangement was better for practical skills.

According to Yildrim, Ozden & Aksul (2001), students who were taught in accordance with traditional lecture and discussion practices demonstrated learning outcomes that were equal to those demonstrated by students who were placed in computer supported learning settings.

Yu, She & Lee (2010) also opined that students in computer supported environment learned more and retained longer learning effects than did students who received a lecture and discussion approach. In Nigeria, the commonest type of teaching technique seems to be the teacher-centred whole-classroom teaching referred to in this study as Conventional Teacher Expository Method (CTEM). This technique, according to Salawu (1999) could be regarded as the vehicle through which a message is delivered. It requires that the learners sit and listen to the teacher as he she presents the content of the day's lesson with students, asking a few questions when necessary and supplying responses when asked to do so by the teacher. This method allows a great deal of information to be passed to the learner and favours handling of large classes which may not be good enough for science practical lessons particularly, Chemistry.

A few studies on the effects of cooperative and individualistic learning strategies on students' learning outcomes have been reported in Nigeria (Aluko, 2010; Oloyede, Adebowale & Ojo, 2012, Odutuyi,2014). These studies focused on comparative effects of cooperative learning strategies and conventional expository method without examining the effectiveness of the computer-supported cooperative instruction and computer-supported individualistic learning settings in Chemistry. It is against this background that, the present study investigated the effects of computer supported cooperative instruction, computer-supported individualistic instruction and the conventional teacher expository method on students' academic performance and retention ability in Secondary School Chemistry.

Statement of the Problem

In recent times, poor performance of students in Chemistry at the Senior Secondary School Certificate Examination (SSCE) level has generated serious concern among science educators. Consequently, researchers have worked on several causative factors such as inadequate laboratory equipment and students' inability to acquire some basic science process skills. However, there seems to be a neglect of other important factors such as the use of an innovative teaching and learning strategy which is computer-supported instruction; hence, this study.

Purpose of the Study

The study investigated the effects of computer-supported learning environment on students' learning outcomes in Secondary School Chemistry. Specifically, the objectives of the study were to:

(1) determine the effects of Computer-Supported Cooperative Instruction (CCI), Computer-Supported Individualistic Instruction (CII), and Conventional Teacher Expository Method (CTEM) on students' performance in Chemistry.
(2) examine the effects of CCI, CII and CTEM on the retention ability of students in Chemistry.

Research Hypotheses

The following hypotheses were formulated andtested at $p<.05$ level of significance.

Ho_1: There is no significant difference in the performance of students exposed to Computer-Supported Cooperative Instruction (CCI), Computer-Supported Individualistic Instruction (CII), and Conventional Teacher Expository Method (CTEM).

Ho2: There is no significant difference in the retention ability of students exposed to CCI, CII and CTEM.

Research Method

The study adopted the pre-test, post-test, control group quasi experimental research design. The population for the study consisted of all the Senior Secondary School three (SSS III) Students offering chemistry in public secondary schools in Ondo State, Nigeria. The sample for the study comprised 149 Senior Secondary three (SS III) Chemistry students in their intact classes. Three out of the 18 Local Government Areas (LGAs) of Ondo State were randomly selected for the study. From these, three schools were purposively selected on the criteria of availability of Chemistry laboratory, ICT facilities (Computer laboratories), gender composition (mixed schools) and registration of students for Senior Secondary School Certificate Examination (SSCE) for at least ten years.

The selected schools were randomly assigned to two treatment groups (CCI) and (CII) and one control group (CTEM). Treatment groups were exposed to Computer-supported Cooperative Instruction (CCI) and Computer-supported Individualistic Instruction (CII) respectively while the control group was taught using Conventional Teacher Expository Method (CTEM). The participants were subjected to orientation activities on cooperative and individualist learning strategies depending on the group they belong to. The students were taught the social skills and principles of intra team cooperation in cooperative learning. The training lasted for two weeks. The teachers who implemented the CCI and CII underwent training on the use of computer-assisted package on cooperative and individualistic learning strategies in order to ensure that it was effectively implemented as planned. The computer Assisted learning package (CALP) was used for test instrument. It was developed by the researcher with the assistance of

a computer programmer and a system analyst. The package was used for teaching Senior Secondary School Chemistry at two different instructional settings (CCI and CII). It was validated by Educational Technology experts, computer programmers, system analysts and Chemistry teachers. The package covered the contents of practical aspects of the SSIII Chemistry curriculum. The units of Chemistry covered included quantitative and qualitative analysis. The main menu of the package consisted of introduction, students' registration, list of lesson as in lesson 1, 2, 3,4, 5,6 and exit. It adopted the drill and practice modes of CAI.

Pretest was administered to experimental and control groups and the results were used as covariate measures in order to account for possible pre-existing differences in overall ability between the experimental and control groups. Immediately after the pretest, the treatment was given by the research assistants (Chemistry teachers) for six (6) weeks. The experimental group 1 was exposed to CCI, experimental group 2 was exposed to CII, while the control group was taught using CTEM. At the end of the treatment, post tests were conducted on the experimental and control groups. Chemistry Practical Achievement Tests (CPAT) was used to collect the data. The CPAT was based on the contents of the CALP. Four weeks after teaching the students quantitative and qualitative analysis using CCI, CII and CTEM, retention test was administered to the three groups (two experimental groups and one control group).

Hypothesis

Hypothesis Ho_1: There is no significant difference in the performance of students exposed to Computer-supported Cooperative Instruction (CCI), Computer-Supported Individualistic Instruction (CII) and Conventional Teacher Expository Method (CTEM).

To test this hypothesis, the students' post-test performance was subjected to a test of difference via Analysis of Covariance (ANCOVA), using the students' pretest scores as the covariates. The result is presented in Table 1.

Table 1

One way Analysis of Covariance (ANCOVA) of Post-test Scores of Chemistry Students taught with CCI, CII and CTEM

Source of Variation	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	9442.227[a]	2	4721.114	39.622	.000
Intercept	477906.568	1	477906.568	4010.868	.000
GRP	9442.227	2	4721.114	39.622	.000
Error	17396.323	146	119.153		
Total	507412.000	149			
Corrected Total	26838.550	148			

a. R Squared = .352 (Adjusted R Squared = .343)

Table 1 shows the result of the test of difference in the students' performance on the basis of the instructional strategies they were exposed to. It can be seen from the table that the value of $F_{(2, 146)} = 39.622$ at $p < .05$. It can therefore be concluded that there is a significant difference in the students' performance on the basis of the instructional strategies they experience. Further a post hoc multiple comparison test was carried out to determine the source of the differences in the students' performance through Tukey HSD. The result is presented in Table 2.

Table 2

Post Hoc (Turkey HSD), Multiple Comparison of Post Test Scores of CCI, CII and CTEM Groups.

(I) GRP	(J) GRP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
CCI	CII	8.905*	2.172	.000	3.76	14.05
	CTEM	19.618*	2.206	.000	14.40	24.84
CII	CII	-8.905*	2.172	.000	-14.05	-3.76
	CTEM	10.713*	2.195	.000	5.52	15.91
CTEM	CCI	-19.618*	2.206	.000	-24.84	-14.40
	CII	-10.713*	2.195	.000	-15.91	-5.52

*. The mean difference is significant at the 0.05 level.

Table 2 shows the result of the post hoc multiple comparison test undertaken to determine the source of the significant difference observed in the students' performance on the basis of the instructional strategies experienced. It can be seen from the table that those in the CCI group seem to perform best in the study. They were found to perform better than those in the CII group (Mean difference = 8.905, $p < .05$) and those in the CTEM group (Mean difference = 19.618, $p < .05$). However, those in the CII group were also found to be better than CTEM (Mean difference = 10. 713, $p < .05$)'

Hypothesis Ho_2: There is no significant difference in the retention ability of students exposed to CCI, CII and CTEM.

To test this hypothesis, the students' retention scores were subjected to a test of difference via Analysis of Variance (ANOVA). The result is presented in Table 3.

Table 3

ANOVA of Retention Test Scores of Students Exposed to CCI,CII and CTEM

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	4866.685	2	2433.342	24.106	.000
Within Groups	14737.825	146	100.944		
Total	19604.510	148			

Table 3 shows the result of the test of difference in the students' retention on the basis of the instructional strategies they were exposed to. It can be seen from the table that the value of $F_{(2, 146)} = 24.106$ at $p < .05$. It can therefore be concluded that there is a significant difference in the students' retention on the basis of the instructional strategies they experience. Furthermore, a post hoc multiple comparison test was carried out to determine the source of the differences in the students' retention through Turkey HSD. The result is presented in Table 4.

Table 4

Post Hoc (Turkey HSD), Multiple Comparisons of Retention Scores of CCI, CII and CTEM Groups.

(I) GRP	(J) GRP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
CCI	CII	5.230*	2.000	.026	.50	9.96
	CTEM	13.970*	2.030	.000	9.16	18.78
CII	CCI	-5.230*	2.000	.026	-9.96	-.50
	CTEM	8.740*	2.020	.000	3.96	13.52
CTEM	CCI	-13.970*	2.030	.000	-18.78	-9.16
	CII	-8.740*	2.020	.000	-13.52	-3.96

*. The mean difference is significant at the 0.05 level.

Table 4 shows the result of the post hoc multiple comparison test undertaken to determine the source of the significant difference observed in the students' retention scores on the basis of the instructional strategies experienced. It can be seen from the table that those in the CCI group seem to retain the knowledge acquired best. They were found to be better in retention than those in the CII group (Mean difference = 5.230, $p < .05$) and those in the CTEM group (Mean difference = 13.970, $p < .05$). However, those in the CII group were also found to be better than CTEM (Mean difference = 8.740, $p < .05$

Discussion

The results of the analysis related to the hypothesis one showed that there is a significant difference in the students' performance between those exposed to CCI, CII and CTEM. Students exposed to CCI performed better than those in CII. Also learners in the CII demonstrated better performance than those in the CII. The result is in agreement with the findings of Yusuf and Afolabi (2010),Yusuf, Gambari and Olumorin (2012) who found that students taught using the computer-supported cooperative learning strategies performed better than those taught using computer-assisted instruction in individualized settings. It also agrees with the findings of Aluko (2008),Doymus (2008) and Gambari, Olumorin and Mudasiru (2012) which established better performance of students taught in cooperative learning settings compared to students using individualistic and conventional classroom instruction respectively.

Furthermore, it also agrees with the findings of Alebiosu, (1998),Olatoye, Aderogba and Aanu (2011) which stated that cooperative method is significantly better than individualized methods. The superiority of the CCI may be due to high level of students' participation in learning activities. All the students in the cooperative group performed specific roles in solving problems which are presented in the laboratory to the benefit of all members of the groups. Weak students benefit from interaction with brighter students and when bright students explain their ideas to others, they learn the material they are explaining in more depth and remember it longer (Johnson and Johnson 1992).

The results of the analysis related to the hypothesis two showed that significant difference existed in the retention ability of students exposed to CCI, CII and CTEM. Also learners in the CCI retained the knowledge acquired best. They were found to be better in retention than those in the CII group and those in the CTEM group. Students in the CCI were also found to be better than CTEM. The findings agree with the findings of Hussain and Ali (2012) that students exposed to computer-assisted instruction retained the concepts taught for a long period of time as compared to the traditional lecture method. It also agrees with the findings of Biswas and Chanda (2013) who reported that the retention of the students were better in science when taught through CAI. However, the findings

disagree with the findings of Owusu, et, al (2010),who found that students that were taught by the conventional method performed better than those taught by CAI. Furthermore, it also agrees with the findings of Anyamene et al (2012) that students taught using CAI performed better than their counterparts taught using the conventional method of instruction in retention test.

Conclusion

Based on the findings of the study, it was concluded that the computer-supported cooperative Instruction (CCI) was effective in enhancing students' academic performance and retention ability in Chemistry.

Recommendations

Based on the findings of this study, the following recommendations are made;

1. Chemistry teachers should expose students to computer-supported cooperative instruction in order to enhance the teaching and learning of the subject.
2. Chemistry laboratories in Secondary Schools should be well equipped with materials, equipment and ICT facilities. This will enable the students to be actively engaged in laboratory activities which will promote meaningful learning of scientific concepts.
3. Chemistry teachers should be exposed to CCI in order to promote social interaction, active students' participation, discovery learning, motivation, learning by doing and learning by experience among students.
4. Teacher education programmes in Nigeria tertiary institutions should be improved upon to prepare teachers who can apply ICT facilities in teaching using computer supported instructional strategy. This will lead to improvement in students' learning outcomes in Chemistry

Implications of the Study

The findings of this study have theoretical and practical implications for enhancing science teaching and learning in Secondary Schools in Nigeria. Theoretically, this study extends the current literature on the use of computer supported cooperative learning strategy and computer supported individualistic learning strategy and their effects on students' performance and retention ability in Chemistry. The findings also provide sound empirical basis that the performance and retention ability of students in Chemistry and other science subjects would be improved if students are exposed to computer-supported cooperative learning strategy

References

Ajaja, O.P & Eravwoke, O.U. (2010). Effects of cooperative learning strategy on junior secondary school students achievement in integrated science. *Electronic Journal of Science Education* . 14(1), 1-18

Alebiosu, K.A (1998). Effects of two cooperative learning models on senior secondary school students learning outcomes in Chemistry. Unpublished Ph. D Dissertation. University of Ibadan, Ibadan.

Aluko, K.O (2008). Teaching chemistry in secondary schools: A case for cooperative instructional strategy. *Ethiopian Journal of Science and Education* 3(2), 27- 34.

Aluko, K.O & Olorundare, A.S. (2007). Effects of cooperative and individualistic instructional strategies on students problem solving abilities in secondary school chemistry in Ilesa, Nigeria. *African Research Review.* 1(1), 121-130

Anyamene, A., Nwokolo, C. Anyachabelu, F. and Anemelu, V,C. (2012). Effect of Computer Assisted Packages on the performance of Senior Secondary students in mathematics in Awka, Anambra State, Nigeria. *American International Journal of Contemporary Research*. 2(7). 61-65.

Biswas, N.B. and Ranjita, C. (2013). Experiments in education and Pedagogy in life science with special reference to Computer Assisted Instruction (CAI). *International Journal of Education Research and Development.* 2(6) 147-151..

Chief Examiner's Report (2009). May/June West African Senior Secondary School Certificate Examination (WASSCE), Yaba, Lagos, Nigeria.

Doymus, K. (2008). Teaching chemical equilibrium with the Jigsaw technique. *Research in Science Education*. *38(2), 249-260.*

Federal Republic of Nigeria (2004). National Policy on Education, Lagos. NERDC press.Gambari, I.A. (2010). Effect of computer-supported cooperative learning strategies on the performance of senior secondary students in physics, in Minna, Nigeria. unpublished Ph. D thesis, university of Ilorin, Ilorin, Nigeria.

Gambari, A.I. & Mogbo, I. N. (2006). Effect of computer-assisted instruction software for individualized physics instruction in secondary schools: Implication for counselling. Book of Proceedings, 1st Annual SSSE, FUT, Minna, 155-164.

Hussain, L. and Ali, U. (2012). Role of CAI on the Interest and Retention of students at secondary school level. *Academic Research International Journal*. 3(2). 337

Johnson, D., & Johnson R., & Holubee, E. (1990). *Cooperation in the classroom, Edina,* MN: interaction book company.

Johnson, D.W. & Johnson, R.T. (1987). Learning together and alone: co-operation and individualization (2nd ed.) New Jersey Eagle Wood Diff.

Johnson, D.W. & Johnson, R.T. (1989). Cooperation and competition: theory and research. interaction book company. Edina, MN.

Johnson, D.W. & Johnson, R.T. (1989). Social skills for successful group work. *Educational Leadership*. 47. 29-33.

Johnson, D.W. & Johnson, R.T. (1992). Implementing cooperative learning. *Contemporary Education*, 63(3), 173-180.

Johnson, D.W. & Johnson, R.T. (1994). Leading the cooperative school (2nd Ed.). Edina, MN: interaction book company.

Odutuyi, M.O.(2014).Effects of laboratory learning environment and Patterns of interactions on students' learning outcomes in secondary school Chemistry. Unpublished Ph. Thesis. Obafemi Awolowo University, Ile-Ife, Nigeria.

Okebukola P.A.O. & Ogurmiyi. M.B. (1984). Cooperative, competitive, and individualistic laboratory interaction patterns: effects on students' performance and acquisition of practical skill. *Journal of Research in Science Teaching.* (21).

Okebukola, P.A. & Ogunniyi, M.B. (1984). Cooperative and competitive and individualistic laboratory interaction patterns: effects on achievement and acquisition of practical skills. *Journal of Research in Science Teaching, 22(9), 198-206.*

Olatoye, R.A; Aderogba A.A & Aanu and Aanu E.M. (2011). Effects of cooperative and individualized teaching methods on senior secondary school students' achievement in organic chemistry. *The Pacific Journal of Science and Technology. 12(2), 310- 319.*

Owusu, K.A., Monney, K.A., Appiah, J.Y and Wilmot, E.M. (2010). Effects of Computer Assisted Instruction on performance of senior high school Biology Students in Ghana. *Computers and Education Journal.* 55(2). 904- 910.

Umaru, J. (2003). Introduction to Computer Studies Book 2. Ilorin: Nathedex Publishers

Yusuf, M. O., Gambari, A.I. & Olumorin, C. O. (2012). Effectiveness of Computer-
Supported Cooperative Learning Strategies in Learning Physics. *International Journal of Social Science. & Education, 2(2), 94-109.*

West African Examination Council (WAEC) (2010). Examiners Report in Science Subjects. Lagos: WAEC.