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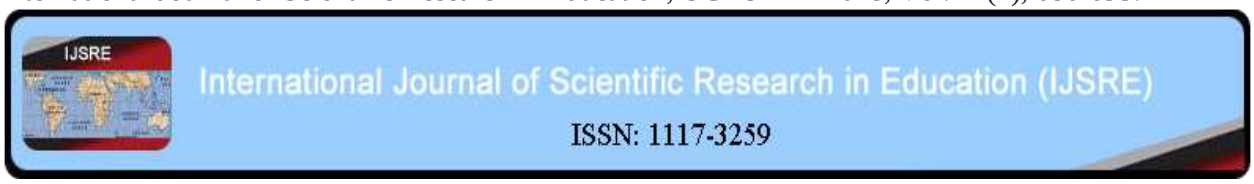

Effects of Computer-Assisted Jigsaw II, Team Assisted Instruction and Learning Together Cooperative Instructional Strategies on Basic Science Students' Attitude, Achievement and Retention in Upper Basic School

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Abstract

This study investigated the effects of Computer- Assisted Jigsaw II, Team Assisted Instruction (TAI) and Learning Together Cooperative Instructional Strategies on Basic Science students' attitude, achievement and retention. Purposive and random sampling procedure were employed to select 105 upper basic II students from four public co-education schools in Federal Capital Territory, Abuja. Quasi experimental design was employed for the study. Three research questions guided the study and three research hypotheses were tested at 0.05 level of significance. Two instruments were used for data collection namely; Basic Science Attitude Questionnaire (BSAQ) and Basic Science Achievement Test (BSAT). The reliability of BSAQ was determined using Cronbach Alpha and the coefficient obtained was 0.79 while Kuder-Richardson formula 21 ($K\text{-}R_{21}$) was used to determine the reliability of BSAT and the reliability coefficient was found to be 0.80 implying that the instruments were reliable enough for the study. Descriptive statistics was used to answer the research questions while the hypotheses were tested using Analysis of Covariance (ANCOVA). The findings of this study revealed significant differences in the attitude, achievement and retention in Basic Science when exposed to Computer-assisted Jigsaw II, TAI and Learning Together Cooperative Instructional Strategies. Basic Science teachers should be encouraged to adopt computer-supported cooperative learning strategies so as to improve and promote social interaction, active learning, discovery learning, motivation, learning by doing and learning by experience among students.

Keyword: Achievement, Attitude, Basic Science, Computer-Assisted, Instructional Strategies and Retention.

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INTRODUCTION

Basic Science is the foundational science subject taught at the Basic School level of the Nigerian educational system. It is a prerequisite subject for science subjects at the Senior Secondary and other applied at the tertiary institutions of learning (Samuel, 2017). The relevance of Basic Science in all fields of Science made it imperative to be included in the curriculum of Basic School as enshrined in the national policy of education (Federal Republic of Nigeria (FRN), 2014).

The purpose of Basic Science education's is to train students to acquire proper understanding of basic principles as well as application. It is also aimed at developing appropriate scientific skills and attitudes as a prerequisite for future scientific activities. Despite the relevance of Basic Science to national development, security, economy, manpower and government's efforts to improve science instruction in schools, students' achievement is below average. This has become a great concern to science educators. Researchers such as Bukunola and Idowu (2012), Osokoya (2013), Alabi (2014), Oni (2014) Kabutu, Oloyede and Bandele (2015) and Samuel (2017) observed that poor instructional strategies employed in the teaching of the subjects by teachers contribute to students under achievement.

In order to achieve the objectives of Basic Science education, the student-activity-based mode of teaching strategies have been recommended by the Federal Republic of Nigeria (FRN, 2014). Also, active participation and collaborative learning activities become imperative and these need functioning instructional media to make Basic Science instruction effective (Osokoya, 2013; Samuel, 2017; Eriba & Samuel, 2018; Agu & Samuel, 2018).

Computer assisted instruction (CAI) refer to instruction or remediation presented on a computer. It is the use computers as an interactive instructional technique whereby a computer is used to present the instructional materials and monitor the learning that take place. It is assisted learning because it allows the learner to interact with instructional techniques. It uses a combination of text, graphics (animation), sound and video in the learning process. Computers could play powerful roles in the child learning in school. That is because it helps to develop learners' potentials in different areas of learning and may also constitute powerful delivery system that may bring about great changes in learners behaviours that are desirable to the society at large. It is noted that, most learning occurs by doing (experimental learning) including getting things wrong as well as getting them right determined by immediate feedback in other words computers appears to be capable of giving almost instant feedback, tirelessly no matter how often learners get it wrong during the process (Furo, 2015).

Computer as instructional material has made a significant contribution to a wide range of group-learning activities. They can, for example, be used to manage or structure a group-learning process, by guiding the group through a simulation exercise of some sort. This can provide a vehicle through or with which a group of learners interact, and gain access to information, investigate simulated situation, which can lead to creativity indeed, virtual all these are ways in which computers can be used to determine pupils interest in learning. It can also be used in group-learning situations. Learners in groups thus, do not only benefit from feedback they receive from the computer, but also from the feedback they receive from one another (Nwafor & Okoi, 2016).

Cooperative learning can be defined as a teaching strategy that involve students in learning process in order to understand and learn content of the subject (Slavin, 1986). Traditional class activities create a win-win situation, where one can only succeed if others loose,

while cooperative learning is direct and opposite of it. In the latter case, conquest of all is success of all. It has been argued that cooperative learning has an edge over other teaching methods in terms of its effectiveness for improved cognition, social skills and motivation (Kabutu, Oloyede & Bandele, 2013; Gull & Shehzad, 2015; Gambari & Yusuf, 2017; Eriba & Samuel, 2018; Agu & Samuel, 2018). There are dozens of strategies that can be used by the teachers under the umbrella of cooperative learning strategies.

In Jigsaw II, students are assigned to three member teams to work with academic materials. Initially, all students are assigned to study and understand the basic concept of the materials. Later, each student is given a section/topic on which to become an expert. Students with the same section/topic meet in expert groups to discuss their topic, after which they return to their original teams to teach what they have learnt to their team mates. The students take group and individual quizzes that result in a team score based on the improvement score system (Slavin, 1986).

Team-Assisted Instruction (TAI) strategy combines cooperative learning with individualized instruction. In TAI, students are assigned into a three-member heterogeneous group. Each team member is placed on a stand-alone and learns the materials individually and proceeds at their own pace. Team mates check each other's work against answer sheets and help each other with any problems. Finally, individual and group unit tests are taken and scored by the teachers. Each week, teachers total the number of units completed by all team members and give certificates or other rewards to the best team (Slavin, 1985; Slavin, Leavey & Madden, 1986).

Learning Together strategy of cooperative learning were originally developed by David Johnson and Rogers Johnson at the University of Minnesota (Harward Education Letter, 2000). Students work in four or five heterogeneous groups on a group assignment sheet. During discussion, the students share their opinions about the task. The learning together strategy of cooperative learning provides a conceptual framework for teachers to plan and tailor cooperative learning strategy according to their circumstances, students' needs and school contexts (Gocer, 2010).

Attitude as a concept is concerned with an individual's way of acting and behaving. It has very serious implications for the learner, the teacher, the immediate social group with which the individual learner relates and the school system. Attitudes are formed as a results of some kind of learner experiences. They may also be learned simply by following the examples, opinions of parents, teachers or friends. This is imitation which also has a part to play in the teaching and learning situation. In this respect the learner draws on his teacher's deposition to form his own attitude which may likely affect his learning outcomes (Eriba, 2013). Negative attitude can lead to low expectations on students 'academics. Also teaching strategies can influence the attitude of students positively or negatively. Reports have shown that improved instructional strategy affects the attitude of students. Gambari and Yusuf (2017) reported that students taught using cooperative learning strategy had positive attitude to the educational benefits derived from group work.

Nwachukwu (2013) viewed achievement basically as the competence a person has in an area of content. This competence is the result of many intellectual and nonintellectual variables. Studies (Akanbi & Kolawale, 2014) have revealed some causes of poor academic achievement in Secondary School Science and instructional strategies ranked very high among other causes identified.

Retention is the ability to hold, keep or recall past experience and reproduce a learnt concept when the need arises (Bukunola & Idowu, 2012). It is an important variable in learning

because only a learnt experience is recalled, learning cannot be said to have taken place if there is no proper retention. The ability of students to recall past learnt Basic Science concepts as an objective of the Basic Science teaching and learning process may likely enhance achievement in the subject. For so long, researchers have been keen on knowing what could be done by teachers to enhance maximum retention of knowledge or skills long after they have been acquired whether in the classroom or outside the classroom (Azuka, 2012; Eriba & Samuel, 2018; Agu & Samuel, 2018).

The aim of the present study was to determine the extent to which classroom exposures to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies could enhance Basic Science students' attitude, achievement and retention. Specifically, the study sought to find out:

- The effect of computer assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies on the attitude of Basic Science students.
- The effect of computer assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies on the achievement of Basic Science students.
- The effect of computer assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies on the retention of Basic Science students.

Research Questions

- What is the mean attitude scores of Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies?
- What is the mean achievement scores of Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies?
- What is the mean retention scores of Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies?

Research Hypotheses

- **H_{O1}:** There is no significant difference in the mean attitude scores of Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies.
- **H_{O2}**: There is no significant difference in the mean achievement scores of Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies**.**
- **H_{O3}**: There is no significant difference in the mean retention score of Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies.

METHODOLOGY

Quasi experimental research design was employed for the study. The sample for study comprised 105 upper basic II Basic Science students from three intact classes purposively selected from three public co-education schools in Federal Capital Territory, Abuja, Nigeria. The schools were purposively sampled based on equivalence in laboratories, ICT facilities and manpower. The

schools were randomly assigned to experimental groups (exposed to Computer-Assisted Jigsaw II (n = 30), TAI (n = 35), Learning Together (n = 40)).

Two instruments were used for data collection namely; Basic Science Attitude Questionnaire (BSAQ) and Basic Science Achievement Test (BSAT). Computer Assisted Instructional Package (CAIP) was the treatment guide used. It was developed by the researcher and a programmer using "Macromedia Dreamweaver 8" as the overall platform, it adopted the drill and practice modes of Computer Assisted Instruction (CAI). BSAQ contained 20 items designed to determine students' attitude in Basic Science, it was rated using a four-point rating scale. The options were; Strongly agree (SA) = 4 points, Agree (A) = 3 points, Disagree (D) = 2 points and Strongly Disagree (SD) = 1 point. Basic Science Achievement Test (BSAT) was a 25-item instrument with options A–D that tested the students' knowledge, comprehension, application of selected topics in Basic Science in Crude oil and Petrol chemicals. The items were allotted 2 marks each, culminating to the total score of 50marks. BSAT was latter reshuffled and used for retention test. The test was validated by three experts in Science and Technology and were trial tested in West Senatorial District of Nasarawa State. The reliability of BSAQ was determined using Cronbach Alpha and the coefficient obtained was 0.79 while Kuder-Richardson formula 21 ($K\text{-}R_{21}$) was used to determine the reliability of BSAT and the reliability coefficient was found to be 0.80 implying that the instruments were reliable enough for the study.

RESULTS

Mean gain scores were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the research hypotheses at 0.05 alpha level of significance.

Research Question One: What is the mean attitude scores of Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies?

The mean gain scores of students' attitude in Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies are presented in Table 1.

Table 1: Mean Attitude Scores of Students' Exposed to Computer-Assisted Jigsaw II, TAI and Learning Together Cooperative Instructional Strategies

Group	Type of Test	No. of Stud.	Mean	Mean Gain
Computer-assisted Jigsaw II	Pre-attitude	30	39.61	25.49
	Post-attitude	30	65.10	
Computer-assisted TAI	Pre-attitude	35	34.97	28.68
	Post-attitude	35	63.65	
Computer-assisted Learning Together	Pre-attitude	40	36.99	28.48
	Post-attitude	40	65.47	

Table 1 show that the Computer-assisted TAI had the highest mean attitude gain scores while Computer-assisted Jigsaw II had the lowest mean attitude gain score.

Research Question Two: What is the mean achievement scores of Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies?

The mean gain scores of Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies are presented in Table 2.

Table 2: Mean Achievement Scores of Students' Exposed to Computer-Assisted Jigsaw II, TAI and Learning Together Cooperative Instructional Strategies

Group	Type of Test	No. of Stud.	Mean	Mean Gain
Computer-assisted Jigsaw II	Pre-test	30	32.19	29.34
	Post-test	30	61.53	
Computer-assisted TAI	Pre-test	35	30.49	32.43
	Post-test	35	62.92	
Computer-assisted Learning Together	Pre-test	40	33.60	29.73
	Post-test	40	63.33	

Table 2 shows that the Computer-assisted TAI had the highest mean gain achievement score while Computer-assisted Jigsaw II had the lowest mean gain achievement score.

Research Question Three: What is the mean retention scores of Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies?

The mean retention gain scores of Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies are presented in Table 3.

Table 3: Mean Retention Scores of Students' Exposed to Computer-Assisted Jigsaw II, TAI and Learning Together Cooperative Instructional Strategies

Group	Type of Test	No. of Stud.	Mean	Mean Gain
Computer-assisted Jigsaw II	Post-test	30	61.53	2.58
	Post-post-test	30	64.11	
Computer-assisted TAI	Post-test	35	62.92	3.06
	Post-post-test	35	65.98	
Computer-assisted Learning Together	Post-test	40	63.33	2.66
	Post-post-test	40	65.99	

Table 3 shows that the Computer-assisted TAI had the highest mean gain retention score while Computer-assisted Jigsaw II had the lowest mean gain retention score.

Hypotheses Testing

H_{O1}: There is no significant difference in the mean attitude scores of Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies.

Table 4: Result of Analysis of Covariance on Students' Attitude in Basic Science Using BSAQ

Source	Type III Sum of Squares	Df.	Mean Square	F	Sig.	Result
Corrected model	6353.063	2	2715.208	102.712	0.000	Sig
Intercept	5071.224	1	5435.017	484.118	0.001	Sig
Pre-attitude	58.762	1	58.762	55.884	0.000	Sig
Group	6727.732	1	4145.114	109.008	0.000	Sig
Error	8310.715	100	65.422			
Total	26521.496	105				

Significant at P<0.05

Table 4 shows a significant difference among the learning strategies on interest, F= ratio of 109.008, P<0.05. The result implies that the instructional strategies produced significant effects on the post attitude scores of students when covariate effect (pre-attitude) was controlled. The null hypothesis of no significant difference was therefore rejected indicating that there is significant difference. This indicates that treatment using Computer-Assisted TAI produced more effect on the attitude of students toward Basic Science.

H_{O2}: There is no significant difference in the mean achievement scores of Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies**.**

Table 5: Result of Analysis of Covariance on Students' Achievement in Basic Science Using BSAT

Source	Type III Sum of Squares	Df.	Mean Square	F	Sig.	Result
Corrected model	4738.172	2	867.511	111.400	0.000	Sig
Intercept	587.071	1	370.028	298.123	0.001	Sig
Posttest	78.812	1	78.812	30.110	0.000	Sig
Group	974.121	1	579.114	181.003	0.000	Sig
Error	3105.111	100	42.801			
Total	9483.287	105				

Significant at P<0.05

Table 5 shows a significant difference among the learning strategies on achievement, F= ratio of 181.003, P<0.05. The result implies that the Computer Assisted instructional strategies produced significant effects on the posttest achievement scores of students when covariate effect (pretest) was controlled. The null hypothesis of no significant difference was therefore rejected indicating that there is significant difference. The result indicates that the treatment using Computer Assisted TAI achieved better than those in the other groups.

H_{O3}: There is no significant difference in the mean retention score Basic Science students exposed to Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies.

Table 6: Result of Analysis of Covariance on Students' Retention in Basic Science Using BSAT

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Result
Corrected model	5117.400	2	541.179	121.101	0.000	Sig
Intercept	321.181	1	370.028	198.313	0.001	Sig
Post-posttest	99.007	1	99.007	56.510	0.000	Sig
Group	704.103	1	421.009	156.503	0.000	Sig
Error	301.711	100	68.411			
Total	6543.402	105				

Significant at $P<0.05$

Table 6 shows a significant difference among the learning strategies on retention, F= ratio of 156.503, $P<0.05$. The result implies that the Computer Assisted instructional strategies produced significant effects on the Post-posttest achievement scores of students when covariate effect (posttest) was controlled. The null hypothesis of no significant difference was therefore rejected indicating that there is a significant difference. The result indicates that the treatment using Computer Assisted TAI retain the concepts taught better than those in the other groups.

DISCUSSION

The findings of this study revealed that the use of Computer-assisted Jigsaw II, TAI and Learning Together cooperative instructional strategies had significant effects on students' attitude, achievement and retention in Basic Science. Computer-assisted TAI had a higher effect on the attitude of students toward Basic Science than those exposed to Computer-assisted Learning Together and Computer-assisted Jigsaw II. This result is in agreement with the findings of Gambari and Yusuf (2017) they found that cooperative instructional strategies have positive effect on students' attitude in Science.

In relation to achievement, the study revealed that the use of Computer-Assisted TAI Cooperative Strategy had a strong effect on the achievement of students toward Basic Science than those exposed to Computer-assisted Learning Together and Computer-assisted Jigsaw II. This finding is consistent with the findings of Kabutu, Oloyede and Bandele (2013), Furo (2015), Gull and Shehzad (2015), Nwafor and Okoi (2016), Gambari and Yusuf (2017), Eriba and Samuel (2018) and Agu and Samuel (2018). They all found out that cooperative instructional strategies enhance students' achievement in Science.

In respect to retention, the study revealed that the use of Computer-Assisted TAI Cooperative Strategy had a strong effect on the retention of students toward Basic Science than those exposed to Computer-assisted Learning Together and Computer-assisted Jigsaw II. This finding is consistent with the findings of Eriba and Samuel (2018) and Agu and Samuel (2018). They all found out that cooperative instructional strategies enhance students' achievement in science.

The findings of this study suggest that exposing Basic Science students to a computer supported learning strategy could improve attitude, achievement and retention toward the subject. This should be given strong emphasis in the teaching of Basic Science in upper basic schools in Nigeria.

CONCLUSION

The findings of this study revealed significant differences in the attitude, achievement and retention in Basic Science when exposed to Computer-assisted Jigsaw II, TAI and Learning Together Cooperative Instructional Strategies.

Recommendations

- Basic Science teachers should be encouraged to adopt computer-supported cooperative learning strategies so as to improve and promote social interaction, active learning, discovery learning, motivation, learning by doing and learning by experience among students.
- Government should provide adequate materials, enabling environment and appropriate training of Basic Science teachers through seminars, workshops and conferences.

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