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RELATIVE EFFECTS OF COMPUTER ASSISTED INSTRUCTIONS (CAI), THINK-PAIR-SHARE TEACHING METHODS AND CHEMISTRY STUDENTS' ACADEMIC ACHIEVEMENT AND RETENTION ON ENVIRONMENTAL POLLUTION IN ITU, NIGERIA

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ABSTRACT

The persistent poor academic achievement of students in the sciences in recent times raises doubts on the efficacy of the teaching methods used by the teachers. Teachers and students perceive the concept of environmental pollution and environmental hazards as being difficult. It is in view of this that the present study sought to explore students' achievement and retention on the concept of environmental pollution when taught using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State. A quasi-experimental design with 2 x2 factorial arrangement was adopted for the study. The study population comprised all the 1000 Senior Secondary Two (SS 2) Chemistry students in all the 19 public co-educational secondary schools in Itu Local Government Area during the 2024/2025 school year. The sample consisted of 141 (SS2) Chemistry students drawn from four intact classes in four-selected co-educational secondary school in the study area using purposive sampling technique. The instrument for data collection was a researcher-developed 25 item, 4-option, multiple-choice test, tagged: Achievement Test on Environmental Pollution (ATEP) with a reliability index of 0.75. The data obtained from the pre-test, post-test and retention tests were analysed using mean, standard deviation and Analysis of Covariance (ANCOVA). The results showed that: there was a significant difference in the students' achievement on the concept of environmental pollution, when taught using Computer-Assisted Instruction and Think-Pair-Share instructional strategies, respectively, in favour of students taught using Computer-Assisted-Instruction; there was a significant difference in the students' retention on the concept of environmental pollution, when taught using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in favour of those taught using Think-Pair-Share Method; that there was no significant difference between the mean achievement and retention scores of male and female students in the concepts taught given the instructional strategies. Consequently, it was concluded that Instructional strategies are significant determinant of students' learning outcomes and not gender; and it was recommended, among others that Chemistry teachers should make effective use of Computer-Assisted-Instruction and Think-Pair-Share teaching methods for better learning outcomes.

Keyword: Relative, Effects, Computer Assisted Instructions (Cai), Think-Pair-Share Teaching Methods, Chemistry Students,' Academic Achievement, Retention, And Environmental Pollution.

INTRODUCTION

Science Education is a field concerned with the production of scientifically literate citizens. Nwanekezie and Arokoyu (2016) defined Science education as the study of the interrelationships between science as a discipline and the application of educational principles to its understanding, teaching and learning. It is concerned with the search for relevant contents and new methods of science teaching and learning. Science education is necessary for national development because its science and technological advancement and the level of scientific literacy of its citizens assess the development of any society. The Nigeria National Policy on Education (Federal Republic of Nigeria, FRN 2013) states that the goals of Science Education in Nigeria include: cultivating inquiry, knowing and rational mind for the conduct of a good life and democracy, producing scientist for national development and service studies in technology and the cause of technological development, producing knowledge of the physical world, and the forms and the conduct of life.

Unfortunately, despite the importance of science education in national development, and the role it plays in socio-economic advancement, Nigeria has not been able to achieve the goals of Science Education. Science education in Nigeria is not adequate to produce skilled human resources needed for transformation into national prosperity (Olalekan and Omosewo, 2018). This is obvious from the poor state of scientific and technological development, and the level of unemployment in the country. Our Science Education cannot empower the learners to bring about sustainable development to the citizens. Our Science Education only equips the learners on how to use technological gadgets rather than on the knowledge of how they are made or maintained. This has contributed to the state of underdevelopment in the country. The only way Science Education can be strengthened is through improvement in its teaching and learning. The recent trends in the development of Science Education in Nigeria have been considered in many articles advocating for science teachers to use modern experimental methods in Science Education on school learning and practice.

Studies conducted by Alpusari and Apriyandi Putra (2015); Ifamuyiwa and Onakoya (2013); Siburian (2014) on the impact of TPS on students' achievement have indicated that students' achievement is enhanced. Sample (2016) suggests that based on the findings, using Think-Pair-Share facilitates increased student participation in class discussion and increases the quality of student responses. Kothiyal, Majumdar, Murthy, and Lyer (2017) while observing the effect of Think-Pair-Share in a large CSI (Computer Science) class, found that Think-Pair-Share is a suitable strategy to use for Computer Science instructors who intend to incorporate active learning techniques in their courses. During the discussion phase, it was observed that students were interested in discussion with their partners. It was recommended that students working in small groups and providing regular feedback was effective for learning. Dol. (2014) found that 99% students agreed that thinking about the problem and writing the solution during the think phase helped them thinking about the problem and writing the solution during the think phase helped them in learning concepts more precisely. Also, 100% students agreed that they found the Think-Pair-Share activity effective. Sugiarno and Sumarsono (2014) explained the implementation of Think-Pair-Share model to improve students' ability in reading narrative texts. Titsankaew (2015) studied the effects of cooperative learning on the students' achievement and attitude and attitude toward mathematics. It was found that using Think-Pair-Share method in the classroom can improve students' achievement and has positive effects on the student's attitude toward mathematics.

Perry, 2014; Bradherry, 2016 and Halpern and Wai, 2019 in separate studies reported no significant mean difference in cognitive test scores between male and female, suggesting there is no gender difference in general intelligence. However, Perry (2014) reported a high significant difference in the standard deviation of intelligence for boys and girls; boys were over represented at both the low and high extremes of cognitive ability. One generalization about males as a whole is that their cognitive abilities appear to be much more variable than females, there are more males at the very high and low ends of the scale than there are females. Smith (2019) asserted that our brains and abilities changes through training, education and experience and that gender difference in intelligence is a myth. Research evidence shows that females tend to excel in language production, synonym generation, word fluency, and all types of memory, anagrams and computation while males excel in Mathematics, problem solving, verbal analogies, mental rotation, spatial perception and tasks that require visual images (Halpern and Wai, 2019).

STATEMENT OF THE PROBLEM

The alarming rate of population explosion in our neighbourhood and attendant increase in waste generation, use of insecticides and allied chemicals, burning of fossil fuels; continued exploration of crude petroleum and flaring of natural gases by oil industries generally affect the environment. Considering the importance of the environment, the environmental and health challenges posed by air, water and land pollution; and in response to the Millennium Development Goal of ensuring environmental sustainability, the concept of environmental pollution and environmental hazards are perceived as being difficult by teachers and students. The persistent poor academic performance of students in the sciences in recent times raises doubts on the efficacy of the teaching methods used by the teachers. It should be noted that the methods of teaching adopted by teachers influence both the students' learning outcomes and their acquisition of science process skills. The nature of science as a dynamic and objective activity presupposes that science teaching should be activity-based, emphasizing science as a mode of inquiry through which knowledge is generated and expanded. This requires learners to be active participants in the teaching-learning process

Unfortunately, studies have shown that the prevalent teaching method in Nigerian schools is the lecture method, which is mainly authoritarian and teacher-centred. It is in view of this that the present study sought to explore students' achievement and retention on the concept of environmental pollution when taught using Computer-Assisted Instruction and Think-Pair-Share instructional strategies. The question then is: how effective will the use of Computer-Assisted Instruction and Think-Pair-Share instructional strategies be in facilitating students' achievement and retention of the concept of environmental pollution? This study was an attempt at finding plausible answer to this question.

PURPOSE OF THE STUDY

The purpose of this study was to investigate the effects of Computer-Assisted Instruction and Think-Pair-Share instructional strategies on students' academic achievement and retention on the concept of pollution in secondary schools in Itu Local Government Area, Akwa Ibom State. The specific objectives of the study were to:

1. Determine the differences among the mean achievement scores of Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share

instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State.

2. Determine the difference between the mean achievement scores of male and female Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State.
3. Determine the differences among the mean retention scores of Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State.
4. Determine the difference between the mean retention scores of male and female Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State.

RESEARCH QUESTIONS

The following research questions we raised to guide the study:

1. What differences exist among the mean achievement scores of Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State?
2. What differences exist between the mean achievement scores of male and female Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State?
3. What differences exist among the mean retention scores of Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State?
4. What differences exist between the mean retention scores of male and female Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State?

RESEARCH HYPOTHESES

The following hypotheses were formulated for testing:

1. There is no significant difference among the mean achievement scores of Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State.
2. There is no significant difference between the mean achievement scores of male and female Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State.

3. There is no significant among the mean retention scores of Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State.
4. There is no significant difference between the mean retention scores of male and female Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State.

SIGNIFICANCE OF THE STUDY

The findings of this study are expected to be significant in the following ways: facilitate students' understanding of the concept while exploring the environment during investigations; provide avenue for students to acquire environmental education; serve as a motivation and encourage students' active participation in the learning process. They are also expected to help the learners acquire relevant skills and knowledge, hence, improve their performance and retention as well as help teachers to be more creative and resourceful in sourcing for instructional materials from learners' own environment. The empirical evidence provided by this study will update existing literature on the use of Computer-Assisted Instruction and Think-Pair-Share instructional strategies in facilitating students' understanding of environmental pollution.

RESEARCH METHOD

In this subsection, the research method is presented under the following subheadings: research design, area of the study, population of the study, sample and sampling technique, instrumentation, validation of the instrument, reliability of the instrument, scoring of the instrument, research procedure and method of data analysis.

THE STUDY AREA

The study was conducted in Itu Local Government Area of Akwa Ibom State.

POPULATION OF THE STUDY

The study population comprised all the 1000 Senior Secondary Two (SS 2) Chemistry students in all the 19 public co-educational secondary schools in Itu Local Government Area during the 2024/2025 school year.

SAMPLE AND SAMPLING TECHNIQUE

The sample consisted of 141 (SS2) Chemistry students drawn from four intact classes in four-selected co-educational secondary school in the study area. Purposive sampling technique was used in selecting the four schools. SS 2 was chosen since the topic under consideration by the researcher falls within their level.

The criteria were:

1. The schools must have a functional Chemistry laboratory;
2. The schools must have professional graduate Chemistry teachers with at least four years of teaching experience teaching the SS 2 class; and
3. Schools that have presented candidates for external examinations for the past five years.

INSTRUMENTATION

The instrument for data collection was a researcher-developed 4-option, 30 multiple-choice test, tagged: Achievement Test on Environmental Pollution (ATEP) lettered A to D, drawn from the concept of Environmental Pollution. The Achievement Test on Environmental Pollution (ATEP) was used for pre-test, post-test, and retention measurements. The post-test and retention tests were the reshuffled version of the ATEP arranged differently in serial numbering and response options.

VALIDATION OF THE INSTRUMENT

The draft of the Achievement Test on Environmental Pollution (ATEP) consisted of 40 items. In order to ensure face and content validity, the draft of the instruments was submitted to three independent assessors, two content experts in the Department of Chemistry, Faculty of Science, and one test and measurement expert, from the Faculty of Education, University of Uyo. These assessors were requested to vet the items for clarity of words, appropriateness to the level of students, content coverage, adequacy in addressing the objectives and problems of the study. Based on their comments and suggestions necessary modifications were made on the instruments. Those items that were found unsuitable were deleted and those that were found appropriate were retained. This reduced the number of items in the validated draft form of the instrument to 25. To ensure content coverage and even distribution of items on the ATEP, a table of the specification was used in preparing the test based on the six levels of Bloom's taxonomy (see Appendix III).

Item Analysis

This involved the determination of the difficulty and discrimination indices of the Achievement Test on Environmental Pollution (ATEP) to further validate the instruments. In order to obtain data for item analysis, the face-validated instrument was trial-tested on a sample of 30 Senior Secondary Two students in a school in the study area, which were not be part of the main study. The data were analysed using the expression.

$$\text{Difficulty Index (p)} = \frac{R}{T} \times \frac{100}{1}$$
$$\text{Discrimination Index (D)} = \frac{R_u - R_l}{0.05N}$$

Where:

- p = Difficulty Index
- R = Total number of students with correct answer to the item
- D = Discrimination index
- N = Total number of students responding to the item
- R_u = Number of students in the upper half will correct answers to the item
- R_l = Number of students in the lower half with correct answers to the item
- N = Number of students responding to the item

Based on the results, items with difficulty indices above 70 % and below 25% were dropped for being too simple and too difficult respectively. Those with discrimination indices below 0.25 and above 0.70 were also dropped for lacking the potentiality to discriminate between the slow

and fast learners; these reduced the items on the Achievement Test on Environmental Pollution (ATEP) to 25.

Reliability of the Instrument

To establish the reliability of the instruments a trial test was conducted using a sample of thirty (30) Senior Secondary Two (SS II) Chemistry students selected from the target population but who were not to participate in the main study. Test-retest approach was used and Pearson Product Moment Correlation Coefficient was used in the determination; and a reliability index of 0.75 was obtained. This indicated that the instrument is reliable and capable of measuring the intended events in this study with consistency (Anselmi *et al.* 2019).

Scoring of Achievement Test on Environmental Pollution (ATEP)

The test consists of 25 items; 4-option multiple-choice questions lettered A - D, with three distracters and one correct option. Each correct answer was scored 4 marks and the incorrect response zero. The total (maximum) mark for all the 25 questions was 100 marks and the minimum was zero (the scoring was measured in percentage).

Experimental Procedure

After selecting the sampled schools the researcher visited and obtained permission from the principals of four selected schools for the study to use their schools for the research and solicited for the cooperation of the Senior Secondary Two (SS II) Chemistry teachers in the selected schools in assisting as research assistants during the exercise. To qualify as research assistants, these Chemistry teachers were subjected to one week training, 3 days in each centre. The objective of the training was to enable the research assistants acquire competence for implementing Computer-Assisted Instruction and Think-Pair-Share instructional strategies. The content of the training package: the behavioural objectives, the content, activities of teacher and students during the teaching learning process as well as administration of the research instruments were all emphasized during the training sessions.

At the end of the research assistants' training, they were exposed to a mock teaching using lesson notes on Computer-Assisted Instruction and Think-Pair-Share instructional strategies, respectively, to ascertain their understanding of the concept of Environmental Pollution and competence and offer help where necessary. Thereafter, the research assistants administered the Achievement Test on Environmental Pollution (ATEP), as pre-test on the students in all the groups before using the treatment package in teaching the concept of Environmental Pollution in their respective groups for four weeks. The students in treatment Group I were taught using Computer-Assisted Instruction and those in Group II were taught using Think-Pair-Share instructional strategy. At the end of the class activities, the students were given a reshuffled version of the Achievement Test on Environmental Pollution (ATEP) as post-test. The retention test was given three weeks after the administration of the posttest. The pre-test, post-test and retention test scripts were collected by the research assistants and handed over to the researcher for marking and scoring. The entire exercise, from training of assistants to administration of retention test, lasted for seven (7) weeks.

Method of Data Analysis

The data obtained from the pre-test, post-test and retention tests were analysed using mean, standard deviation and Analysis of Covariance (ANCOVA). Mean and standard deviation were

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used to answer the research questions while ANCOVA was used to test the null hypotheses raised at 0.05 level of significance. SPSS 25.0 was used to analyse the data.

Decision Rule

When the calculated p-value was greater than 0.05, the null hypotheses was retained but when it was less than 0.05, the null hypotheses was rejected.

Ethical Issues

The principles of confidentiality, anonymity and informed consent were strictly observed in the course of this research. Prior to carrying out the research, the authorities of the schools selected were informed of the intent of the researcher, and permission obtained to use the schools and the students. The conditions given by the different school authorities were strictly adhered to. The student respondents were not compelled to participate in the exercise; rather, they were encouraged to freely participate in the research without the researcher’s influence; and their privacy was respected. In the course of the research work, the procedure for gathering data did not cause any physical or emotional harm to the respondents, as the researcher did not conceal any information from them. The research assistants were trained and instructed on the need for upholding ethical standards. Data obtained were used solely for academic purposes. The confidentiality of the subjects’ identities were strictly adhered to.

RESULTS

Under this subhead, the summary of results used in answering the four research questions and testing the four null hypotheses formulated to guide the study, are presented, and interpreted.

Research Question 1: What differences exist among the mean achievement scores of Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State?

Table 4.1: Mean (X) and standard deviation of students’ pre-test and post-test scores on ATEP classified by treatment groups

Treatment Groups	N	Pre-test		Post-test		Mean Gain Score
		̄	sd	̄	sd	
Computer-Assisted-Instruction	71	26.20	6.14	64.68	4.01	38.48
Think-Pair-Share	70	27.03	5.08	54.94	6.63	27.91

Table 4.1, shows the pre-test and post-test mean scores and standard deviation of scores of the three groups of students taught using Computer-Assisted-Instruction and Think-Pair-Share teaching/learning strategies. The post-test - pre-test mean gain scores of 38.48; and 27.91, respectively, for those in Computer-Assisted-Instruction and Think-Pair-Share Method groups showed those taught using Computer-Assisted-Instruction had better mean gain score compared with those taught using Think-Pair-Share. The post-test standard deviation scores of 4.01 and 6.63, respectively, for students in Computer-Assisted-Instruction and Think-Pair-Share Method groups indicate that, students taught using Computer-Assisted-Instruction also had the closest scattering of post-test raw scores about the group mean. The Table also shows

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that all the groups had post-test mean scores that are higher than their pre-test mean scores. The results for testing hypothesis one displayed in Table 4.2 was used to assess whether the observed differences in the mean scores of the two groups were statistically significant.

Hypothesis One: There is no significant difference among the mean achievement scores of Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State.

Table 4.2: Summary of One Way Analysis of Covariance (ANCOVA) of the students' post-test scores on ATEP classified by treatment groups with pre-test as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision at p<.05 alpha
Pretest	557.73	1	557.73	21.38	.000	s
Treatment	3525.47	1	3525.47	135.16	.000	s
Error	3599.59	138	26.08			
Total	675816.00	141				
Corrected Total	4579.19	140				

a. R Squared = .520 (Adjusted R Squared = .513)

In Table 4.2, the calculated F-ratio for the effect of treatment at df 1 138 is 135.16; and alpha level of 0.00 is 0.46. This level of significance is less than .05 in which the decision is based; indicating that there was a significant difference in the students' achievement on the concept of environmental pollution, when taught using Computer-Assisted Instruction and Think-Pair-Share instructional strategies, respectively. With this observation, null hypothesis 1, was rejected. The results in Table 4.1 show that students taught using Computer-Assisted Instruction had better mean gain score compared with those taught using Think-Pair-Share instructional strategy.

Research Question 2: What differences exist between the mean achievement scores of male and female Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State?

Table 3: Mean (M) and standard deviation of students' pre-test and post-test scores on ATEP classified by treatment groups and gender

Treatment Groups	Gender	N	Pre-test		Post-test		Mean Gain Score
			M	sd	M	sd	
Computer-Assisted Instruction	Male	39	26.51	5.46	65.23		38.72
	Female	32	25.81	6.96	4.20		38.19
Think-Pair-Share	Male	34	26.47	4.43	64.00	3.73	28.00
	Female	36	27.56	5.64	55.39	7.02	27.83

Table 4.3, shows the pre-test and post-test mean scores; and standard deviation of scores of the male and female students taught using Computer-Assisted Instruction and Think-Pair-Share

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instructional strategies. The pre-test-post-test mean gain scores of male and female students in the Computer-Assisted Instruction group displayed are 38.72 and 38.19, respectively. The pre-test-post-test mean gain scores of male and female students in the Think-Pair-Share group displayed are 28.00 and 27.83, respectively.

These observations show that the male students taught using Computer-Assisted Instruction had higher mean gain scores followed by their female counterparts in the same group. Table 4.3, also that the scattering of the raw scores about the post-test mean was widest for the females in the Think-Pair-Share group. The results for testing hypothesis two displayed in Table 4.4 was used to assess whether the observed differences in the mean scores of the two groups were statistically significant.

Hypothesis Two: There is no significant difference between the mean achievement scores of male and female Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State.

Table 4: Summary of 2 x 2 Analysis of Covariance (ANCOVA) of the students' post-test scores on ATEP classified by treatment groups and gender with pre-test as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision at p<.05 alpha
Pre-test	538.39	1	538.39	20.467	.00	s
Treatment	3474.56	1	3474.56	132.09	.00	s
Gender	1.75	1	1.75	.07	.80	ns
Treatment * Gender	20.23	1	20.23	.77	.38	ns
Error	3577.56	136	26.31			
Total	512460.00	141				
Corrected Total	7496.56	140				

a. R Squared = .523 (Adjusted R Squared = .509)

In Table 4.4, the calculated F-ratio for the main effect of instructional strategies at df 1,136 is 132.09, while its corresponding calculated level of significance is .00 alpha. This level of significance is less than .05 in which the decision is based; indicating that there was a significant difference between the mean achievement scores of students in the concepts taught given the instructional strategies used. However, the F-cal. value for the main effect of gender at df 1, 136 was .07 while its significant level is .80. This significant level is greater than .05 alpha in which the decision is based, indicating that the influence of gender on the students' achievement was not statistically significant. With this observation, null hypothesis 2 was upheld.

Research Question 3: What differences exist among the mean retention scores of Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State?

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Table 4.5: Mean (X) and standard deviation of students' post-test and retention scores on ATEP classified by treatment groups

Treatment Groups	N	Post-test		Retention		Mean Score Difference
		\bar{x}	sd	\bar{x}	sd	
Computer-Assisted-Instruction	71	64.68	4.01	56.93	3.94	-7.75
Think-Pair-Share	70	54.94	6.63	51.20	6.70	-3.74

Table 4.5, shows the post-test and retention mean scores and standard deviation of scores of the two groups of students taught using Computer-Assisted-Instruction and Think-Pair-Share teaching/learning strategies. The retention- post-test mean scores difference of -7.75 and -3.74, respectively, for those in Computer-Assisted-Instruction and Think-Pair-Share Method groups showed those taught using Think-Pair-Share Method had better mean scores difference compared with those taught using Computer-Assisted-Instruction, indicating better retention. The retention standard deviation scores of 3.94 and 6.70, respectively, for students in Computer-Assisted-Instruction and Think-Pair-Share Method groups indicate that, students taught using Computer-Assisted-Instruction also had the closest scattering of retention raw scores about the group mean. The Table also shows that all the groups had retention mean scores that are lower than their post-test mean scores. The results for testing hypothesis three displayed in Table 4.6 was used to assess whether the observed differences in the mean scores of the two groups were statistically significant.

Hypothesis Three: There is no significant among the mean retention scores of Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State.

Table 4.6: Summary of One Way Analysis of Covariance (ANCOVA) of the students' retention scores on ATEP classified by treatment groups with post-test as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision at p<.05 alpha
Posttest	3949.70	1	3949.70	2389.05	.000	s
Treatment	275.98	1	275.98	166.93	.000	s
Error	228.15	138	1.65			
Total	417788.00	141				
Corrected Total	4579.19140					

a. R Squared = .957 (Adjusted R Squared = .957)

In Table 4.6, the calculated F-ratio for the effect of treatment at df 1 138 is 166.93; and alpha level of 0.00. This level of significance is less than .05 in which the decision is based; indicating that there was a significant difference in the students' retention on the concept of environmental pollution , when taught using Computer-Assisted Instruction and Think-Pair-Share instructional strategies, respectively. With this observation, null hypothesis 3, was rejected.

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Research Question 4: What differences exist between the mean retention scores of male and female Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State?

Table 7: Mean (\bar{x}) and standard deviation of students' pre-test and post-test scores on ATEP classified by treatment groups and gender

Treatment Groups	Gender	N	Post-test		Retention		Mean Score Difference
			\bar{x}	sd	\bar{x}	sd	
Computer-Assisted Instruction	Male	39	65.23	4.20	57.59	3.93	-7.64
	Female	32	64.00	3.73	56.13	3.87	-7.87
Think-Pair-Share	Male	34	54.47	6.25	50.76	6.53	-3.71
	Female	36	55.39	7.02	51.61	6.91	-3.78

Table 4.3, shows the post-test and retention mean scores; and standard deviation of scores of the male and female students taught using Computer-Assisted Instruction and Think-Pair-Share instructional strategies. The retention-post-test mean scores difference of male and female students in the Computer-Assisted Instruction group displayed are -7.64 and -7.87, respectively. The retention -post-test mean score difference of male and female students in the Think-Pair-Share group displayed are -3.71 and -3.78, respectively.

These observations show that the male students taught using Think-Pair-Share had better mean score difference followed by their female counterparts in the same group. Table 4.3, also that the scattering of the raw scores about the retention mean was widest for the females in the Think-Pair-Share group. The results for testing hypothesis four, displayed in Table 4.8 was used to assess whether the observed differences in the mean scores of the two groups were statistically significant.

Hypothesis Four: There is no significant difference between the mean retention scores of male and female Chemistry students taught the concept of pollution using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in secondary schools in Itu Local Government Area, Akwa Ibom State.

Table 8: Summary of 2 x 2 Analysis of Covariance (ANCOVA) of the students' retention scores on ATEP classified by treatment groups and gender with post-test as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision at $p < .05$ alpha
Post-test	3900.74	1	3900.74	2338.39	.00	s
Treatment	275.46	1	275.46	165.13	.00	s
Gender	.87	1	.87	.52	.47	ns
Treatment * Gender	.42	1	.42	.25	.62	ns
Error	226.87	136	1.67			
Total	417788.00	141				
Corrected Total	5334.98	140				

a. R Squared = .523 (Adjusted R Squared = .509)

In Table 4.8, the calculated F-ratio for the main effect of instructional strategies at df 1,136 is 165.13, while its corresponding calculated level of significance is .00 alpha. This level of significance is less than .05 in which the decision is based; indicating that there was a significant difference between the mean retention scores of students in the concepts taught given the instructional strategies used. However, the F-cal. value for the main effect of gender at df 1, 136 was .52 while its significant level is .47. This significant level is greater than .05 alpha in which the decision is based, indicating that the influence of gender on the students' retention was not statistically significant. With this observation, null hypothesis 4, was upheld.

FINDINGS

From the results in Tables 1- 8 the following observations were made:

1. There was a significant difference in the students' achievement on the concept of environmental pollution, when taught using Computer-Assisted Instruction and Think-Pair-Share instructional strategies, respectively, in favour of students taught using Computer-Assisted-Instruction.
2. There was no significant difference between the mean achievement scores of male and female students in the concepts taught given the instructional strategies used.
3. There was a significant difference in the students' retention on the concept of environmental pollution, when taught using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in favour of those taught using Think-Pair-Share Method.
4. There was no significant difference in the male and female students' retention on the concept of environmental pollution, when taught using Computer-Assisted Instruction and Think-Pair-Share instructional strategies.

DISCUSSION

The findings with regard to the effect of using Computer-Assisted Instruction and Think-Pair-Share instructional strategies, respectively, on students' achievement on the concept of environmental pollution, showed that there was a significant difference when taught using Computer-Assisted Instruction and Think-Pair-Share strategies, respectively, in favour of students taught using Computer-Assisted-Instruction.

This observation is in line with those of Gachi (2024) who also reported a significant difference in student achievement in favour of students who were taught using Computer-Assisted-Instruction. The observed significant difference in students' achievement in favour of those are taught using Computer-Assisted-Instruction is explained in terms of activity-based learning instructions which provided active learning environment that engaged the learners in high order thinking tasks as analysis, synthesis and evaluation which in turn enhanced the students' cognitive achievement.

On the influence of gender on students' achievement, when taught using Computer-Assisted Instruction and Think-Pair-Share strategies, respectively, it was observed that its influence was not statistically significant. This observation indicates that students' gender is not a strong determinant of students' academic outcomes.

With regard to the effect of using Computer-Assisted Instruction and Think-Pair-Share instructional strategies, respectively, on students' retention on the concept of environmental pollution, showed that there was a significant difference in the students' retention on the

concept of environmental pollution, when taught using Computer-Assisted Instruction and Think-Pair-Share instructional strategies in favour of those taught using Think-Pair-Share Method. The observed significant difference on students' retention in favour of those are taught using Think-Pair-Share Method is explained in terms of increased student participation in class discussion and increased quality of student responses. which in turn enhanced the students' retention.

On the influence of gender on students' retention, when taught using Computer-Assisted Instruction and Think-Pair-Share strategies, respectively, it was observed that there was no significant difference in the male and female students' retention on the concept of environmental pollution, when taught using Computer-Assisted Instruction and Think-Pair-Share instructional strategies. This observation indicates that students' gender is not a strong determinant of students' academic outcomes.

CONCLUSION

Based on the findings of the study, it is hereby concluded that Computer-Assisted Instruction is a significant determinant of students' achievement, whereas gender is not; and that Think-Pair-Share Method is an effective facilitating strategy for enhancing students' retention; whereas gender had no effect on the students' retention.

RECOMMENDATION

Based on the findings and the conclusions reached, the following recommendations are made:

1. Chemistry teachers should make effective use of Computer-Assisted-Instruction and Think-Pair-Share teaching methods for better learning outcomes. learning
2. Government in conjunction with professional bodies like STAN should endeavour to organize and sponsor regular workshops to train science teachers on the use of both Computer-Assisted-Instruction and Think-Pair-Share teaching learning methods for better learning outcomes.

Suggestion for Further Study

Consequent upon the findings made and conclusion reached, it is hereby recommended that:

1. A similar study should be conducted in other Local Government Areas in Akwa Ibom State and other States of the Federation to allow for effective generalization of the findings.
2. The study should be replicated in other science subjects such as physics and chemistry.
3. Further research is recommended to verify the findings of the current study.

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