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COMPUTER ANIMATION INSTRUCTIONAL STRATEGY AND STUDENTS' ACADEMIC ACHIEVEMENT IN CHEMISTRY IN UYO LOCAL GOVERNMENT AREA OF AKWA IBOM STATE

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ABSTRACT

The study investigated the effect of computer animation instructional strategy on students' academic achievement in chemistry in Uyo Local Government Area of Akwa Ibom State. Three research questions and three hypotheses guided the study. The study adopted a quasi-experimental research design in a non-randomized pretest, posttest setting. The study sample comprised of 195 SS2 Chemistry students in public coeducational secondary schools in the study area selected using multi-stage sampling technique. Instrument for gathering data for the study was Achievement Test on Chemistry Quantitative Analysis (ATCQA) with a reliability index of .78. The data obtained were analyzed using mean, standard deviation and analysis of covariance (ANCOVA). The result showed that students taught using computer animation instructional strategy achieved significantly better than the students taught using the conventional expository teaching strategy. Gender and school location had no significant influence on students' achievement in chemistry. Consequently, it was recommended among others, that science teachers, especially chemistry teachers should be trained on the use of computer animation instructional strategy in teaching abstract concepts in science.

KEYWORDS: Computer, Animation, Academic Achievement, Chemistry

INTRODUCTION

Chemistry is a pure science subject that deals with composition, properties, reactions and structure of matter. Daniel and Ekanem (2023) opined that Chemistry has helped in the development of modern technology through the application of its principles in modern inventions. The study of Chemistry has been and will remain of paramount importance to mankind because Chemistry is capable of explaining natural phenomena and everyday occurrence such as burning of wood, rusting of nails, fermentation and the spontaneous emission of radiation by elements. It has contributed to the growth and development of Nigeria and the world at large (Ekanem and Daniel, 2024). Chemistry has made food more abundant by improving agricultural production, providing shelter for protection and clothes to cover our nakedness. It also provides us with medicine for health care and fuel for transportation. A sound knowledge of Chemistry is therefore of great importance to science students and the society at large. However, despite the relevance and usefulness of Chemistry, studies have shown that students' performance in Chemistry has been relatively low in contemporary times (Daniel *et al.,* 2024).

Students' difficulties in learning Chemistry concepts have been attributed to the abstract, complex and conceptually demanding nature of chemistry (Daniel and Ekanem, 2023). Most of the students' weaknesses are attributed to lack of knowledge on balancing of chemical equations, inability to answer questions in electrolysis, lack of understanding of oxidation reduction reactions, lack of knowledge of I.U.P.A.C system of nomenclature and inadequate exposure to practicals such as acid-base titrations (WAEC Chief Examiners' Report, 2023).

Evidently, poor academic achievement of secondary school students in Chemistry seems to have risen in recent history. The problem of inconsistency in Chemistry achievement has adverse effects on students and the society at large if not properly addressed. Considering the critical role of Chemistry in national development, it is needful to lay a solid foundation in students to enhance their academic achievement and proficiency. Appropriate measures need to be taken to ensure that Chemistry teachers adopt the right approach in teaching chemistry so as to minimize students' failure rate and limit poor achievement by students in Chemistry. In the past, several attempts have been made at solving these problems but such efforts had focused more on ways of improving the popular conventional methods of teaching (Ekanem and Daniel, 2022). Little or no attention has been given to the use of innovative teaching methods such as the use of Information and Communication Technology (ICT) in Chemistry instructional delivery (Ebonam and Nwanneka 2020).

Technology has greatly impacted on education globally by improving teaching and learning. In recent years, computer technology has permeated into the society in such a way that almost everything being done involves the use of computer. Hence, science teachers need to key into the current trend. To achieve this, chemistry teachers need to change their lesson delivery from the use of conventional methods to innovative methods that suits the needs of this current generation.

Conventional method of teaching is a teacher-led method of instruction which most teachers prefer to use in their instructional delivery. This method amongst others includes lecture method, discussion, project, demonstration and expository teaching method. These methods are popular and often used by teachers to disseminate information, knowledge and skills to students (Adigun, 2016). For the purpose of this research, conventional method simply refers to the expository teaching method. The researcher chooses this method because most chemistry teachers prefer using it to other conventional method of instruction. Inspite of its advantages, expository teaching method has serious disadvantages of emphasizing only on superficial learning instead of in-depth knowledge of facts (Gongden, 2015). There is need therefore, for the teachers to adopt other innovative teaching methods that have the potency to improve achievement such as computer animation instructional strategy.

Computer animation is a product of modern technologies. It is defined as a set of varying images presented dynamically according to users' action in ways that help the user to perceive a continuous change over time and develop a more appropriate mental model of a task (Ikwuka and Samuel, 2017). It involves the use of graphics to produce moving images. A typical example of computer animation could be likened to the action of robot which is seen on television performing the action of cooking or gathering items into a basket. In chemistry quantitative analysis, computer animation can be used to visualize the movement of cations and anions since they cannot be seen with the naked eye in the laboratory. Computer animation reduces abstraction and tends to improve the achievement of students (Zanin, 2015). According to Yara and Bolarinwa (2025) computer animation produces special effects and stimulates images that would be impossible to show with non-animation techniques. It is a form of dynamic representation that display processes and change over time. The flexibility of learning through animation allows for a wider range of stimuli, thus, increasing learners' engagement in learning. According to Zanin (2015), computer animation is expressed as an enriched device in which pictures are synchronized in the teaching and learning process in order to make it real. Asiedu, et al (2024) stated that computer animation instructional strategy is a brilliant and innovative teaching strategy that encourages learners to communicate ideas and learn concepts in a creative and original way. It can be particularly useful as a tool in knowledge acquisition that encourages creative thinking in sciences students. Animation could be interesting and have the power to gain the attention and interest of the learners for hours without boring them, this could be helpful to learners since it possess features that aids in learning difficult concepts that ordinarily would have not been possible.

Researchers report that computer animation instructional strategy fosters high academic achievement in science and chemistry in particular (Gongden, et al, 2020, Ikwuka *et al.,* 2017, Asiedu, *et al.,* 2024, Yara and Bolarinwa and Samuel, 2025). However, it seems the use of computer animation

instructional strategy in teaching chemistry in Nigerian Secondary schools has not attracted much attention as chemistry classroom activities are still dominated with teacher-centered conventional teaching methods. This had therefore made it necessary to investigate the effectiveness of computer animation instructional strategy on senior secondary school chemistry students' achievement in Uyo Local Government Area of Akwa Ibom State.

Gender is considered as one of the variables that may likely affect the academic achievement of students in the study. Gender is often used to indicate distinction between human beings on the basis of masculinity and feminity in relation to their expected roles (Daniel *et al.,* 2024). Eya and Ezeh (2020) asserted that gender is an analytical concept that describes the sociological roles and cultural responsibilities and expectations of men and women in a given society or cultural setting. Studies on gender as it affects students' academic achievement in chemistry are inconclusive. Eze and Eyah (2020) and Daniel and Ekanem (2023) observed that there was no significant influence of gender on students' achievement in chemistry, while Oludipe (2020) and Ndukwe (2021) observed that gender has a significant influence on students' academic achievement in chemistry. Since studies on gender have been inconsistent, gender as a variable attracts further investigation in this study.

School location is another variable of interest in this study. School location refers to a particular place in relation to other areas in the physical environment (rural or urban) where school is sited (Oludipe, 2020). Ekanem and Daniel (2022) observed that school location has no significant influence on the academic achievement of students in chemistry. On the contrary, Oludipe (2020) observed that chemistry students in urban schools achieved significantly better than their rural counterparts. Against these contradictory findings, it is imperative to ascertain the influence of school location on the academic achievement of chemistry students.

STATEMENT OF PROBLEM

Chemistry has helped in the development of modern technology through the application of its principle to modern inventions. The role of chemistry notwithstanding in national development and the current analysis of students' achievement in chemistry revealed that students' achievement has remained poor over the years in spite of the effort to improve the learning of chemistry at the secondary school level. Some researchers have blamed the poor achievement on a number of factors such as ineffective instructional strategies adopted by chemistry teachers and difficulty in understanding some basic concepts in chemistry such as acid-base titrations. The traditional approaches have not enhanced students' achievement in quantitative analysis and chemistry in general, hence the need to find out whether computer animation instructional strategy can enhance students achievement in quantitative analysis. What would be the effects of computer animation instructional strategy on students' achievement in quantitative analysis in chemistry?

RESEARCH QUESTIONS

The following research questions guided the study:

(1) What difference exist between the achievement mean scores of chemistry students in quantitative analysis when taught using computer animation instructional strategy and those taught using expository teaching methods?
(2) What is the influence of gender on chemistry students' academic achievement in quantitative analysis?
(3) What is the influence of school location on chemistry students' academic achievement in quantitative analysis?

RESEARCH HYPOTHESES

The following null hypotheses were formulated for testing at .05 alpha level

1. There is no significant difference in the achievement mean scores of chemistry students in quantitative analysis when taught using computer animation instructional strategy and expository teaching method.
2. There is no significant difference between the academic achievement of male and female students in quantitative analysis in chemistry
3. There is no significant difference between the academic achievement of urban and rural students in quantitative analysis in chemistry

RESEARCH METHODS

The study adopted the quasi-experimental research design in a non-randomized pre-test, post-test setting. Intact classes were randomly assigned to the groups. The population of the study consisted of all the 2852 senior secondary two chemistry students in all the 14 public coeducational secondary schools in Uyo Local Government Area of Akwa Ibom State in 2024/2025 school year. The sample was 195 senior secondary two chemistry students from four intact classes in four secondary schools in the study area selected using multi-stage sampling technique. Firstly, the study area was stratified into urban and rural strata. Ten schools were identified as urban schools while four schools were identified as rural schools. Secondly, two rural schools and two urban schools were selected through balloting using simple random sampling technique. Finally, one arm of intact senior secondary two class from each of the selected rural and urban schools were randomly assigned to the experimental group and control group. Thus, one intact class from the urban and rural schools were randomly assigned to computer animation instructional strategy group and expository teaching method group.

All the 195 students were pretested with Achievement Test on Chemistry Quantitative Analysis (ATCQA). The instrument was 25-item instruments on quantitative analysis in chemistry develop for collection of pretest and posttest scores. The items were developed on multiple choice options of A to D with only one correct option that carried the correct answer. Students were required to choose the option that carried the correct answer. The instrument was face and content validated by three independent assessors; two content experts in chemistry education and one measurement and evaluation expert. Test-retest reliability strategy was adopted to generate data to establish the reliability of the instrument. The data generated were analyzed using Pearson Product Moment Correlation (PPMC). The analysis yielded a reliability coefficient of .78.

Teachers in the experimental group were trained on the procedure of teaching quantitative analysis in Chemistry using Computer Animation Chemistry Instruction (CACI) with the aid of a computer and a projector. After the training, the students in the experimental group were taught quantitative analysis using the Computer Animation Chemistry Instructions with the aid of computer and projectors in their respective classrooms. Students in the control group were taught quantitative analysis in chemistry using the conventional expository teaching methods.

The treatment which lasted for two weeks was done in their intact class settings with the help of their chemistry teachers that were trained by the researchers. ATCQA was administered to the students in both groups as post test. The data obtained were analyzed using mean and standard deviation in answering the research questions, while analysis of covariance (ANCOVA) was used in testing the null hypothesis.

RESULTS

Table 1: Mean and Standard Deviation of Students' Pre-test and Post-test scores classified by Treatment groups

Treatment Groups	N	Pre-test		Post-test		Mean Difference
		Mean	SD	Mean	SD	

Experimental Group	**97**	**7.24**	**3.21**	**38.42**	**6.72**	**31.18**
Control Group	**98**	**8.18**	**4.30**	**20.72**	**4.16**	**12.54**

Data in Table 1 show that the pre-test and post-test mean scores with standard deviation for the experimental group (computer animation instructional strategy) are 7.24, 38/42 and 6.72 respectively. However, the pretest and post-test mean scores with standard deviation scores for the control group (expository teaching method) are 8.18, 20.72, 4.30 and 4.16 respectively. Table 1 also shows that the means **difference** of the experimental group is 31.18 against the mean difference of 12.54 of the control group indicating the superiority of computer animation instructional strategy group over the expository teaching method group in Chemistry quantitative analysis.

Table 2: Summary of Analysis of Covariance (ANCOVA) of Students' Post-test Scores Classified by Treatment Groups with Pretest Scores as Covariates

Source	Type II sum of squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected model	1631.679[a]	2	815.839	14.808	.000	.481
Intercept	8470.967	1	8470.967	153.754	.000	.307
Pre-test	3.223	1	3.223	0.59	.890	.480
Treatment	1267.531	1	1267.537	23.007	.000	.329
Error	4805.127	193	24.897	-	-	-
Total	211554.000	195	-	-	-	-
Corrected Total	6536.072	194				

a. R Squared = .742 (Adjusted R squared = .716)

In table 2, the calculated F-ratio for the effect of treatment at df 1,193 is 23.007, while its corresponding calculated level of significance is .000 alpha. This level of significance is less than .05 in which the decision is based, indicating that there was a significant difference in the achievement of students taught using computer animation instructional strategy and expository teaching method. With the observation, the null hypotheses one was rejected. This means that there is a significant difference between the achievement means scores of chemistry students in quantitative analysis when taught using computer animation instructional strategy and expository teaching method.

Table 3: Mean and Standard Deviation Scores of Male and Female Students' Pre-test and Post-test scores taught Quantitative Analysis in Chemistry using Computer Animation Instructional Strategy and Expository Teaching Method.

Gender	N	Pre-test		Post-test		Mean Difference
		Mean	SD	Mean	SD	
Male	98	5.96	3.96	28.14	4.73	22.21
Female	98	6.27	4.31	30.60	5.81	24.21

Data in Table 3 shows the pre-test and post-test mean scores of male students as 5.96 and 28.14 respectively. However, the pre-test and post-test mean scores for female students are 6.27 and 30.60 respectively. Table 3 also shows that the means difference of male students is 22.21 against the mean difference of 24.21 of the female students. A comparison of these results show that the achievement of the female students was slightly higher than that of their male counterpart.

Table 4: Summary of Analysis of Covariance (ANCOVA) of Students' Post-test Scores Classified by Gender Groups with Pretest Scores as Covariates

Source	Type II sum of squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected model	4874.185	2	2437.092	118.421	.000	.642
Intercept	2311.126	1	2311.126	140.016	.000	.421
Pre-test	814.216	1	814.216	32.111	.000	.381
Treatment	1482.341	1	1482.341	154.491	.000	.512
Gender	52.427	1	52.427	.431	.281	.012
Error	4872.294	193	25.245	-	-	-
Total	872141.126	195	-	-	-	-
Corrected Total	8421.264	194				

a. R Squared = .724 (Adjusted R squared = .714)

Data in table 4 show that the F-cal value for the main effect of gender given the teaching strategies used at df 1,193 is .421 while its significant level is .281. This significant level is greater than .05 alpha in which the decision is based, indicating that the influence of gender on students' achievement was not statistically significant. With this observation, null hypothesis two was upheld.

Table 5: Mean and Standard Deviation Scores of Urban and Rural Students' Pre-test and Post-test Scores taught Quantitative Analysis In Chemistry using Computer Animation Instructional Strategy and Expository Instructional Strategy

School Location	N	Pre-test		Post-test		Mean Difference
		Mean	SD	Mean	SD	
Urban	98	5.88	4.40	38.88	6.01	33.00
Rural	97	5.81	4.70	39.24	5.84	33.43

Data in Table 5 show the pre-test and post-test mean scores of urban students as 5.88 and 38.88 respectively. However, the pre-test and post-test mean scores for rural students are 5.81 and 39.24 respectively. Table 5 also shows that the mean difference of urban students is 33.00 against the mean difference of 33.43 of the rural students. A comparison of these results shows that the achievement of rural students was slightly higher than their urban counterparts.

Table 6: Summary of Analysis of Covariance (ANCOVA) of Students' Post-test Scores Classified by School Location Groups with Pretest Scores as Covariates

Source	Type II sum of squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected model	4621.542a	2	2310.771	120.812	.000	.682
Intercept	2624.494	1	2624.494	108.410	.000	.481
Pre-test	792.119	1	792.119	31.614	.000	.411
Treatment	4281.781	1	4281.781	161.142	.000	.614
School Location	96.172	1	96.172	1.813	.261	.071
Error	4682.174	193	24.259	-	-	-
Total	85138.010	195	-	-	-	-
Corrected Total	7814.520	194				

a. R Squared = .712 (Adjusted R squared = .731)

DISCUSSION OF THE FINDINGS

The findings with regards to the effect of computer animation instructional strategy on students' academic achievement in quantitative analysis in Chemistry show that there was a significant difference between the achievement mean scores of Chemistry students in quantitative analysis when taught using computer animation instructional strategy and expository teaching method. Students taught using computer animation instructional strategy performed significantly better than students taught using the conventional expository teaching method. The better enhancing effects of computer animation instructional strategy could be attributed to the fact that computer animation integrates text and images, each contributing to improved memory retention through visual engagement. This finding is in line with the findings of Ikwuka and Samuel, (2017), Gongden, *et al.,* (2020) and Yara and Bolarinwa (2025). According to Asiedu, *et al.,* (2024) computer animation instructional strategy is a brilliant and innovative teaching strategy that encourages learners to communicate ideas and learn concepts in a creative and original way.

As regards the influence of gender given the instructional strategies used, the findings showed that the influence of gender on students' achievement in chemistry was not statistically significant. Computer animation instructional strategy provides an efficient learning environment that gives both male and female students equal opportunities to learn. The findings agree with Eya and Ezeh (2020) and Daniel and Ekanem (2023) that there was no significant influence of gender on students' achievement in chemistry. However, the findings disagree with Ndukwe (2021) that male students performed significantly better than female students in Chemistry.

The findings with regards to the influence of school location on chemistry students' academic achievement when taught using computer animation instructional strategy and expository teaching strategy showed that the influence of school location on students' achievement was not statistically significant. This could be attributed to the enhancing effects of computer animation instructional strategy. The no significant influence of school location reported in the study is in agreement with the findings of Ekanem and Daniel (2022) and Daniel, et al (2024). Conversely, the finding disagrees with Oludipe (2020) that students in urban schools achieved significantly better than their rural counterparts.

CONCLUSION

Based on the findings of the study, it was concluded that the use of computer animation instructional strategy improved students' understanding of the concept of Quantitative analysis in

Chemistry. This explains why the academic achievement of the students in experimental group improved more than that of the control group. Also, gender and school location had no statistically significant influence on Chemistry students' academic achievement in quantitative analysis.

RECOMMENDATIONS

The following recommendations were made based on the findings of the study:

- **Science teachers, especially chemistry teachers should be trained on the use of computer animation instructional strategy in teaching abstract concepts in science**
- **Curriculum planners should incorporate the use of computer animation instructional strategy in the curriculum to enhance the teaching and learning of science concepts**
- **Science teachers should endeavour to use computer animation instructional strategy in teaching science concepts.**

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