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Effects of Blended Learning and Expository Instructional Strategies on Senior Secondary School Students' Performance Based on the Concept of Atomic Structure

[1,]Aniefiok I. Udoh , [2,]Mfon E. Udo
[1, 2], *Department of Science Education, University of Uyo, Uyo, Nigeria*

ABSTRACT: In spite of the research efforts over the years, students' difficulty in achievement and retention of chemical structure and bonding concepts has continued to persist among secondary school students. Consequently, this study sought to determine the relative effectiveness of blended learning and computer simulation instructional strategies in facilitating secondary school students' achievement and retention in this concept area. In pursuance of the objectives, eight research questions and eight hypotheses were formulated to guide the study. The study was a quasi-experimental research, and non-randomized pre-test, post-test design was used. The study sample comprised one hundred and fifty-three (153) Senior Secondary One (SS1) Chemistry students in four intact classes in four co-educational secondary schools in Eket Local Government Area of Akwa Ibom State selected using multi-stage sampling technique. The study area was divided into urban and rural strata. Two public co-educational schools were selected from each strata using simple random sampling and assigned to experimental group one and experimental group two respectively. A researcher-made fifty (50) item multiple choice test tagged: Achievement Test on Atomic Structure and Chemical Bonding (ATASCB) were developed, validated, with a reliability index of .78, determined using Pearson's Product-Moment Correlation. The test designed to measure the students' pre-test, post-test and retention achievements was used for data collection. The data obtained from all the tests were analysed using mean, standard deviation, independent t-test and Analysis of Covariance (ANCOVA). The results obtained showed that of the two teaching strategies investigated, blended learning is the more effective in facilitating students' academic achievement and retention in the concept. The findings showed that students taught using blended learning strategy retain the concepts taught significantly better than those taught using computer simulation strategy. Also, that gender, and school location had no statistically significant influence on the students' achievement; and in the interaction effects investigated, none was statistically significant. Based on the findings it has been recommended, among others that Chemistry teachers should make effective use of blended learning strategy in teaching the concept of atomic structure and chemical bonding in chemistry. Also, Curriculum planners should ensure the incorporation of this strategy in the teaching and learning of chemistry concepts.

KEYWORD: Standard Deviation, Independent T-Test and Analysis of Covariance (ANCOVA)

I. INTRODUCTION

Throughout the world, education is considered to be an important tool for attaining national goals as it provides learners with skills needed for survival. In view of the significance of education and the role of information technology (IT) as instrument for national development, Nigeria educational philosophy and methodology has undergone reform to match the ideals and challenges of ever changing economy and social structure of a modern society loaded with information, communication technology (ICT). The predominance of Information Communication Technology (ICT) in the present 21st century has created a serious challenge and the need for educationists to make effective use of these tools in teaching and learning becomes imperative. ICT currently provides a growing range of tools to manipulate digital data, as well as access to the vast range of information which underpins the information age. Science may be regarded as a body of related courses concerned with knowledge. It consists among other components; Chemistry, Physics, Biology, Mathematics, Astronomy, Agriculture and Geology. In Nigeria, chemistry is one of the science subjects offered at the Senior Secondary School level. The Senior Secondary School level is a 3-year study after the 3-year Junior Secondary School and it is at this level that chemistry is first introduced as a separate subject. Chemistry as a relevant and experimental science subject demands a proactive teaching method with effective students' involvement in hands-on-minds-on experiences to generate knowledge, develop scientific skills, attitude and social values that would equip them to solve problems and contribute to national development (Udofia, 2016). The current generation of secondary school students, are called "digital natives" (Prensky, 2001; Proserpio and Gioia, 2007), this is because off their dexterity in the use of technology to enhance their social interaction, shop online and access online educational materials.

Learning chemistry without appropriate understanding of the fundamental concepts from the beginning of the studies may have negative implications on students' achievement. Chemistry education seeks to develop in the learner the ability to observe and manipulate physical things so that their noticeable characteristic outcome on interaction with other forms of matter or properties under different conditions can be identified and utilized in solving man's problem (Odo, 2013). Considering the importance of chemical bonding in chemistry and the fact that students frequently experience difficulty in chemical bonding, this present study tend to focus on this aspect of chemistry in order to enhance better understanding of other topics in chemistry (Nahum, Mamlok-Naaman, Hofstein, and Kronik,2008). To do this, effective instructional strategies had to be put in place to enhance effective teaching and learning of chemical bonding. This study therefore, examined two instructional strategies that may enhance better understanding of the concept of chemical bonding. The instructional strategies are blended learning and expository instructional strategies. Blended learning provides opportunity for greater quality of human interaction in the learning process. It also provides a mix of technologies and interactions that result in a socially supportive and constructive learning experience (Holm, 2011). Researchers LIKE (Graham, 2006; Graham and Dziuban, 2009) have advanced three primary reasons for adopting a blended approach to instruction, to include: improved learning effectiveness; increased access and convenience and greater cost effectiveness. Therefore, it becomes a necessity that students understand the basic concepts in chemistry as they learn it in secondary schools.

Poor teaching has been indicated as a major problem that results in candidates' poor achievement in Chemistry in external examinations (WAEC Chief Examiner's reports, 2007). Many learners experience difficulties when learning seemingly abstract chemistry concepts because of ineffective instructional strategies used by teachers; and also, concepts are being taught at theoretical level with no visual or audio-visual representation. Consequently, learners fail cognate concepts and therefore develop a negative perception towards chemistry. These perceptions may account for the reduced number of learners studying chemistry at the senior secondary school level, when compared to other subjects. This calls for the need for a possible intervention which could improve the teaching and learning of chemistry in secondary schools for increased enrolment and better results in WASSCE. According to Eshiet (2009) and Stephen (2016), the best approach in the teaching of a particular concept or phenomenon is the presentation of the real objects in the learning units as teaching facilities, such as real specimens of plants or animals and real machines or tools as they are known to exist or used in life situations. A major challenge to chemistry educators is to teach these processes so that students can comprehend and understand the underlying principles. Because of this challenge, chemistry educators are looking for new teaching and learning strategies that will enhance students learning of Atomic Structure so as to bring about better achievement in their overall performance in both internal and external examinations. In order to remedy the poor instructional delivery that characterise the present day chemistry classroom as observed by Njoku 2007, Adesoji and Ibraheem (2009) which also translate to the persistent poor performance among students, researchers over time have used several strategies such as: teams-achievement divisions' strategy, exploratory-discovery strategy and so on. None of these strategies seem to meet students needs in learning chemistry, given it abstract nature. It is on his premise therefore that the researcher investigated the effects of blended learning and expository instructional strategies on students' academic performance in Chemistry in Eket, Akwa Ibom State.

II. THEORETICAL FRAMEWORK

Theory of Cognitive Development by Vygotsky (1978) and theory of cognitive learning by Piaget (1972) provides the theoretical framework for this study. Vygotsky Theory of Cognitive Development is based on the belief that people construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences. It is also based on the belief that students learn best when they gain knowledge through exploration and active learning. Jean Piaget theory of cognitive learning proposes that the basis of all learning is the child's own activity as the child interacts with the physical and the social environment. This theory also sees the teacher as a facilitator or a guide in the teaching and learning process whose role is to provide a rich environment for spontaneous exploration of the students. This will prepare learners to perform logical operations under real world situation as a means to reinforcing their capability to carry out some logical processes such as observing, describing, classifying and measuring real objects.

Statement of the Problem: Performance is pivotal to student's progress from one level to another in school. Most chemistry students seem to have trouble with chemistry concepts that are abstract in nature. This has led to poor performance and in some cases, outright dislike for the subject among senior secondary school students. The abstract nature of Atomic Structure tends to be a source of worry to both teachers and students. Atomic

Structure is an important and fundamental area in chemistry. The study of Atomic Structure offers insights into how objects are held together and the way the world works. However, as important as Atomic Structure is in chemistry, students perceive them as difficult. In the past, the teaching and learning of Atomic Structure has relied heavily on methods that make the teacher a talker and the student's only passive listeners in class. Persistent poor students' performance in chemistry has therefore become very worrisome to teachers, parents and all education stakeholders.Researchers have tried over the years to remedy the menace of failure and poor performance among secondary school chemistry students and the poor performance among students in chemistry has been attributed to certain factors such as poor teacher qualification, lack of instructional materials, infrastructure, socio-economic status and of course the teaching strategy used by teachers. Despite the research efforts over the years, students' difficulty in performance of Atomic Structure has continued to persist among secondary school students. It is worrisome that chemistry classroom today is dominated with teaching strategies that cannot meet students' achievement and retention needs.

It therefore becomes necessary to investigate the effect that blended learning and expository instructional strategies would have on the academic performance of students with respect to the concept of Atomic Structure and how these strategies will improve students' performance given their gender and school location. The question now is: does blended learning and expository instructional strategies bring about improved academic performance in students? This study seeks to find out possible solution to these problem and many more.

III. RESEARCH QUESTIONS

- The following research questions were raised to guide the study:
- What is the difference in the mean score of students taught the concept of Atomic Structure in chemistry using blended learning strategy and those taught with expository instructional strategy?
- What is the mean score of male and female students taught the concept of Atomic Structure in chemistry using blended learning and expository instructional strategies?
- What is the interactive effect of blended learning and expository instructional strategies on students' performance in atomic structure in chemistry?

Research Hypotheses

- The following null hypotheses were tested at 0.05, level of significance.
- There is no significant difference in the mean score of students taught the concept of Atomic Structure in chemistry using blended learning and expository instructional strategies.
- There is no significant difference in the mean score of male and female students taught the concept of Atomic Structure in chemistry using blended learning and expository instructional strategies.
- There is no significant interaction effect of blended learning and expository instructional strategies on students performance in Atomic Structure in chemistry.

IV. METHODOLOGY

Research Design: The study adopted a 2 x 2 quasi-experimental non-equivalent pre-test and post-test research design. This research design is relevant because allows the researcher to establish cause and effect of the variable herein manipulated.

Population of the Study: The population of the study consisted of all the 1,120 Senior Secondary One Chemistry students in all the nine (9) public co-educational secondary schools in Eket Local Government Area of Akwa Ibom State. The choice of Senior Secondary One students was due to the fact that Atomic Structure is indicated on their curriculum. Thus, it is assumed that the students do not have any prior knowledge of the concept to be investigated. This enabled the researcher to investigate students' academic performance atomic structure when exposed to the two instructional strategies.

Sample and Sampling Technique: The study sample comprised one hundred and fifty-three (153) comprising 66 males and 87 females Senior Secondary One chemistry students in four secondary schools in the area of study. The sample was selected using multi-stage sampling technique. First, the area of study was divided into urban and rural areas. Next, two public co-educational secondary schools were randomly selected from each of the areas of the study using simple random sampling technique. Finally, one arm of intact SS1 class from each of the selected schools was randomly selected and assigned as either Experimental group one or two using simple random sampling technique. Thus, two schools each, from urban and rural areas was randomly assigned experimental group one which was treated with expository instructional strategy and experimental group two treated with blended learning strategy, respectively.

Instrumentation: A researcher made instrument tagged: Performance Test on Atomic Structure (PTAS) was developed – as pre-test and post-test. The PTAS was a fifty (50) item multiple choice achievement test drawn from the concept of Atomic Structure. Each question had four (4) options A, B, C and D with only one correct answer and three wrong answers. The test was composed of two forms; form one was the pre-test while form two was a reshuffled version of the PTAS used as post-test. To ensure content coverage and even distribution of items on the PTAS, content validity, test blue-print or table of specification was used in preparing the test which was based on the six levels of cognitive domains of Bloom's taxonomy of educational objectives.

Validity of the Instrument: This involved both face and content validity, and item analysis through the draft of Performance Test on Atomic Structure (PTAS) consisted of 60 items. In order to ensure its face validity, it was submitted for expert judgements to two content experts in chemistry education, one expert in test construction to check for the appropriateness of the items in terms of the language used, class level, and content coverage. Based on the comments and suggestions made, the researcher was appropriately guided in the development of the valid instrument. The instrument was adjusted accordingly. The number of items was reduced to fifty (50). In this way, face validity was established for the performance test on Atomic Structure.

Reliability of the Instrument: The reliability of the Performance Test on Atomic Structure (PTAS) was determined using test-retest method. A trial test was administered once to twenty-five SS one chemistry students in a school in Eket L.G.A which was not part of the sample but was part of the population of the study. The second test was administered two weeks after the first test. Data generated from the trial test were analysed using Kuder Richardson (KR-21) formula. The result showed reliability index of 0.78. This is an indication that the instrument is reliable and capable of measuring the intended events in this study with stability over 2 week's period (Thorndike and Morgan, 1977).

Experimental Procedure : After selecting the sample schools using multi-stagesampling technique, the researcher visited and obtained permission from the principals of the four selected schools for the study to use their schools for the research and also solicit for the cooperation of the SS1 chemistry teachers in assisting as research assistants during the exercise. Permission granted, the researcher intimated the SS one chemistry teachers of her mission and solicited their cooperation as research assistants. This was followed by a random selection of intact classes from among the various arms of SS one students in the selected schools. To qualify as research assistants, the four chemistry teachers from the four schools selected for the study were subjected to one week training on how to carry out the teaching using validated lesson notes, expository instructional and blended learning approaches in order to ensure uniformity and mastery of the different strategies. The research assistants for experimental group one were trained on how to use expository instructional strategy while those in experimental group two were trained on how to blend technology-mediated instruction with demonstration and discussion. The research assistants were given the copies of the validated lesson plans and the instructional packages on expository instructional teaching of Atomic Structure and blended learning approaches. At the end of the training session, the researcher assessed the research assistants as each of them undertook a mock presentation session using the specific teaching strategy assigned to him/her in-order to measure their level of compliance and to offer help where necessary.

Following the training of the research assistants, the Performance Test on Atomic Structure (PTAS) was administered on all the students in all the treatment groups prior to the treatment as pre-test by the research assistants. The pre-test served as covariate to control for the initial differences among the subjects. Thereafter, the treatment package prepared by the researcher was used by the research assistants in teaching the concept of Atomic Structure in their respective groups for four weeks. The students in treatment group one were treated using the expository instructional strategies; while those in treatment group two were treated using blended learning strategies.Experimental group one was taught Atomic Structure using expository instructional strategy.For experimental group two, Atomic Structure were taught using a mix of demonstration, discussion methods and technology-mediated instructionsin an interactive manner. Students were first arranged in small groups of 5-6 members according to the number the research assistants would manage. With the research assistants, students embarked on interactive activities and discussions on the concept being taught while demonstrating where applicable the atomic structure. In addition, students carried out the activities built into the lesson packages in the CD-ROMS while the research assistants acted as facilitators. There was much interaction between the teacher and the students. Laptop, projector, copies of research instruments and source of power was made available to all research assistants to enable them use the technology-mediated instructions/lesson plan effectively. For the Experimental group two enough copper wires and beads of different colours were made available to be used in the demonstrations. The teaching in all the groups was done during the normal class periods for chemistry and in intact class setting.

This was to avoid disrupting the school programme. At the end of the treatment session, the reshuffled version of Performance Test on Atomic Structure (PTAS) was administered on all the treatment groups as post-test under the supervision of the researcher. This was to assess the performance of the two teaching\learning strategies investigated. Test scripts from the pre-test and post-test administrations were collected immediately at the end of each test by the research assistants who submitted same to the researcher.

V. METHOD OF DATA ANALYSIS

The data generated were analysed using Mean, Standard Deviation, and Analysis of Covariance (ANCOVA) statistics. Mean scores and standard deviation were used for answering the research questions while ANCOVA was used in testing the null hypotheses at 0.05, level of significance.

Data Analysis and Results : In this section, the summary of results used in answering the eight research questions and testing the eight null hypotheses formulated to guide the study, are presented and interpreted variable by variable.

Answering the Research Questions and Testing the Hypotheses : The eight research questions raised are answered in this subsection.

Research Question 1: What are the achievement mean scores of students in the concept of chemical structure and bonding in chemistry when taught using computer simulation and when taught using blended learning strategy?

Table 1: Mean (X) and standard deviation of students' pre-test and post-test scores classified by treatment groups

Treatment Groups	N	Pre-test		Post-test		Mean Gain Score
		$\bar{X}$	sd	$\bar{X}$	sd	
Blended Learning	72	26.19	6.17	64. 90	3.90	38.71
Computer Simulation	81	26.20	5.28	54.62	6.01	28.42

Table 1, shows the pre-test and post-test mean scores and standard deviation of scores of the two groups of students taught using computer simulation and blended teaching/learning strategies. The pre-test mean scores of 26.19 and 26.20 for those in blended learning and computer simulation groups, respectively; and the post-test mean scores of 64.90and 54.62 for those in blended learning and simulation groups, respectively, show that the blended teaching/learning strategy group had the best mean gain (38.71) . The post-test standard deviation scores of 3.90 and 6.01 for those in blended learning and computer simulation groups, respectively, show that the scattering of the raw scores from the mean is wider in the computer simulation group. This indicates that although the mean score of the blended learning group is high, the standard deviation of the raw score from the mean is low. Expectedly all the groups had post-test mean scores that are higher than the pre-test mean scores. Whether the differences between the mean scores of the two groups taught using computer simulation and blended learning strategies were statistically significant is assessed by testing of hypothesis one.

Hypothesis One: There is no significant difference among the achievement mean scores of students in the concept of chemical structure and bonding in chemistry when taught using computer simulation and when taught using blended learning strategy.

Table 2: Summary of Independent t-test analysis of the students' post-test scores classified by treatment groups

Treatment groups	N	Mean score	Std. Dev'n	Std. Error Mean	Df	t-cal	Sig.	Decision at p<.05
Blended Learning	72	64.90	3.86	.45				
					151	12.41	.00	S
Computer Simulation	81	54.62	6.01	.67				

In Table 2, the calculated t-ratio for the effect of instructional strategies at df 151 is 12.41, 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 in the academic achievement of students in the concepts taught using computer simulation and blended teaching /learning strategies. With this observation, null hypothesis 1 was rejected. This means that there is a significant difference among the mean scores of students on the concept of chemical structure and bonding in chemistry when taught using computer simulation and when taught using blended learning strategy in favour of those taught with blended learning strategy.

Research Question 2: What are the achievement mean scores of male and female students in the concept of chemical structure and bonding in chemistry when taught using computer simulation and when taught using blended learning strategy?

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

Treatment Groups	Gender	N	Pre-test		Post-test		Mean Gain Score
			$\bar{X}$	sd	$\bar{X}$	sd	
Blended learning	Male	38	26.89	5.54	66.00	4.16	39.11
	Female	34	25.41	6.81	63.65	3.09	38.24
Computer	Male	28	24.79	5.06	53.93	5.21	29.14
simulation	Female	53	26.94	5.29	54.91	6.41	27.97

Table 3, shows the pre-test and post-test mean scores and standard deviation of scores of the male and female students in the two groups taught using blended learning and computer simulation strategies. The pre-test mean scores of male and female students in the blended teaching/learning groups displayed are 26.89 and 25.41 respectively, and their standard deviation scores are 5.54 and 6.81, respectively. The post-test mean scores are 66.00 and 63.65 for male and female students, respectively, while their standard deviation scores are 4.16 and 3.09, respectively. The mean gain scores for male and female students are 39.11 and 38.24 respectively.
With respect to those in the computer simulation group, the pre-test mean scores of the male and female students displayed are 24.79 and 26.94 respectively, and their standard deviation scores are 5.06 and 5.29, respectively. The post-test mean scores are 53.93 and 54.91 for male and female students, respectively, while their standard deviation scores are 5.21 and 6.41, respectively. The mean gain scores for male and female students are 29.14 and 27.97, respectively. These observations show that the male students in blended teaching/learning group had a highest mean gain scores followed by their female counterparts in the same group, the males and female in the computer simulation group in decreasing order. Also, the scattering of the raw scores about the post-test mean was widest for the females in the computer simulation group. Whether the differences between the mean scores of the two groups taught using the two teaching strategies by gender were statistically significant is assessed by testing of hypothesis two.

Hypothesis Two: There is no significant difference among the achievement mean scores of male and female students in the concept of chemical structure and bonding in chemistry when taught using computer simulation and when taught using blended learning strategy.

Table 4: Summary of Analysis of Covariance (ANCOVA) of male and female students' post-test scores classified by treatment groups with pre-test scores as covariate

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision at p<.05 alpha
Pre-test	347.87	1	347.87	14.83	.00	S
Treatment	3837.88	1	3837.88	163.56	.00	S
Gender	19.89	1	19.89	.85	.36	Ns

Treatment * Gender	52.07	1	52.07	2.22	.14	Ns
Error	3472.73	148	23.46	-	-	-
Total	548728.00	153	-	-	-	-
Corrected Total	7961.88	152	-	-	-	-

a. R Squared = .564 (Adjusted R Squared = .552)

In Table 4, the calculated F-ratio for the main effect of instructional strategies at df 1,152 is 163.56, 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 academic achievement of students in the concepts taught given the instructional methods used. However, the F-cal value for the main effect of gender at df 1, 152 was .36 while its significant level is .14. This significant level is greater than .05 alpha in which the decision is based, indicating that the influence of gender on the students' performances was not statistically significant. With this observation, null hypothesis 2 was upheld.

Research Question 3: What are the achievement mean scores of urban and rural students in the concept of chemical structure and bonding in chemistry when taught using computer simulation and when taught using blended learning strategy?

Table 5: Mean and standard deviation of students' pre-test and post-test scores classified by treatment groups and school location

Treatment Groups	Location	N	Pre-test		Post-test		Mean Gain Score
			$\bar{X}$	sd	$\bar{X}$	sd	
Blended learning	Urban	37	26.16	6.81	64.54	3.70	38.38
	Rural	35	26.23	5.53	65.26	4.03	39.03
Computer simulation	Urban	40	27.55	4.74	55.25	6.57	27.70
	Rural	41	24.88	5.50	54.00	5.40	29.12

Table 5, shows the pre-test and post-test mean scores and standard deviation of scores of the Urban and Rural students in the two groups taught using blended learning and computer simulation strategies. The pre-test mean scores of Urban and Rural students in the blended teaching/learning groups displayed are 26.16 and 26.23 respectively, and their standard deviation scores are 6.81 and 5.53, respectively. The post-test mean scores are 64.54 and 65.26 for Urban and Rural students, respectively, while their standard deviation scores are 3.70 and 4.03, respectively. The mean gain scores for Urban and Rural students are 38.38 and 39.03 respectively.
With respect to those in the computer simulation group, the pre-test mean scores of the Urban and Rural students displayed are 27.55 and 24.88 respectively, and their standard deviation scores are 4.74 and 5.50, respectively. The post-test mean scores are 55.25 and 54.00 for Urban and Rural students, respectively, while their standard deviation scores are 6.57 and 5.40, respectively. The mean gain scores for Urban and Rural students are 27.70 and 29.12, respectively.

These observations show that the rural students in blended teaching/learning group had the highest mean gain scores followed by their urban counterparts in the same group; the Rural and the urban students in the computer simulation group in decreasing order. Also, the scattering of the post-test raw scores about the mean was widest for the urban students in the computer simulation group. Whether the differences between the mean scores of the two groups taught using the two teaching strategies by school location was statistically significant is assessed by testing of hypothesis three.

Hypothesis Three: School location has no significant influence on students' achievement mean scores in the concept of chemical structure and bonding in chemistry when taught using computer simulation and when taught using blended learning strategy.

Table 6: Summary of Analysis of Covariance (ANCOVA) of Urban and f Rural students' post-test scores classified by treatment groups with pre-test scores as covariate

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision at p<.05 alpha
Pre-test	368.89	1	368.89	15.46	.00	S
Treatment	4025.50	1	4025.50	168.75	.00	S
School location	.34	1	.34	.01	.91	Ns
Treatment * School location	13.66	1	13.66	.57	.45	Ns
Error	3530.49	148	23.86	-	-	-
Total	548728.00	153	-	-	-	-
Corrected Total	7961.88	152	-	-	-	-

a. R Squared = .557 (Adjusted R Squared = .545)

In Table 6, the calculated F-ratio for the main effect of instructional strategies at df 1,152 is 168.75, 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 academic achievement of students in the urban and rural schools taught using blended learning and computer simulation strategies. However, the F-cal value for the main effect of school location at df 1, 152 was .01 while its significant level is .91. This significant level is greater than .05 alpha in which the decision is based, indicating that the influence of school location on the students' performances was not statistically significant. With this observation, null hypothesis 3 was upheld.

VI. DISCUSSION OF FINDINGS

In this section the findings from the results in Tables 1-14 are discussed in the order of the research questions/hypotheses.

Blended Learning, Computer Simulation and Students' Achievement : The findings with regard to the effect of blended learning and computer simulation strategies on students' achievement on chemical structure and bonding in chemistry were statistically significant. Students taught using blended learning strategy performed significantly better than those taught using computer simulation strategy. The statistically significant better enhancing effect of blended learning strategy on the students' learning achievements could be attributed to the interactive effect of the various instructional strategies blended on the learners' cognitive structure. This may have spurred their curiosity in learning, thereby promoting knowledge construction, deeper understanding of concepts and greater command and mastery of content. The accruable effect being manifested through improved academic achievement. The findings of this study is consistent with Almasaeid (2014) who indicated that blended learning strategy had an effect on students' achievement and also increases students' interaction and understanding of the content. The finding also supports Abidoye (2015), who stated that bended learning instructional strategy is more effective in enhancing student achievement.

Blended Learning, Computer Simulation, Gender and Students' Achievement: On the influence of gender on the students' achievement on chemical structure and bonding in chemistry when taught using blended learning and computer simulation strategies it was observed that its influence was not statistically significant. This observation indicates that gender is not a strong determinant of students' academic achievement. This result could be possible in view of the fact that computer simulation and blended learning strategies could lead to concepts being grasped easily, retained and also recalled by students in spite of their gender. The no significant influence of gender observed in this study agrees with those of Abidoye (2015) and Ezeudu and Ezinwanne (2013) but disagrees with that of Odagboyi (2015) who reported better achievement of the males. This observation indicates inconsistent and inconclusive findings with regards to gender and students' achievement.

Blended Learning, Computer Simulation, School Location and Students' Achievement : With respect to the influence of school location on the students' achievement on chemical structure and bonding in chemistry

when taught using blended learning and computer simulation strategies, it was observed that its influence was not statistically significant. This observation indicates that school location is not a strong determinant of students' academic achievement. The no significant influence of school location observed in this study agrees with those of Josiah (2002) which stated that the achievement in Physics of students (irrespective of location), is enhanced when Physics is taught and learnt using Computer- Assisted Instruction (CAI), but disagrees with that of Owoeye and Yara (2011), which stated that there was a significant difference in between students' academic achievement of rural and urban secondary schools in senior school certificate examinations. Their study proved that students in urban areas had better academic achievement than their rural counterparts.

Blended Learning, Computer Simulation and Students' Retention: The findings with regard to the effect of blended learning and computer simulation strategies on students' retention of concepts on chemical structure and bonding in chemistry were statistically significant. Students taught using blended learning strategy retained the concepts taught significantly better than those taught using computer simulation strategy. The statistically significant better enhancing effect of blended learning on the students' retention is consistent with Umar, Idris, Audu, Arah, Yusuf and Beji (2017) who also reported a higher students' retention when taught using multimedia instructional approach. This observation could be explained in terms of the interactive nature of this instructional approach which accommodates the varied learning styles of the students.

Blended Learning, Computer Simulation, Gender and Students' Retention : On the influence of gender on the students' retention of concepts on chemical structure and bonding in chemistry when taught using blended learning and computer simulation strategies, it was observed that its influence was not statistically significant. This observation indicates that gender is not a strong determinant of students' academic achievement and retention. The no significant influence of gender observed in this study agrees with those of AbduRaheem (2012) and Ezeudu and Ezinwanne (2013) which attest to the fact that gender is only a cultural construct and not a factor to be associated with academic achievement.

Blended Learning, Computer Simulation, School Location and Students' Retention : As regards the influence of school location on the students' retention of concepts on chemical structure and bonding in chemistry when taught using blended learning and computer simulation strategies, it was observed that its influence was statistically significant. This observation indicates that location is a strong determinant of students' retention. The no significant influence of school location observed in this study agrees with those of Okereke and Onwukwe (2011), but disagrees with that of Josiah (2012) no significant difference in the mean physics achievement scores between urban and rural students when taught using computer assisted instruction (CAI)

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Interaction Effects of Treatment, Gender, and School Location on Students' Achievement : With respect to the interaction effects of treatment by gender, treatment by school location, gender by school location and treatment by gender by school location on the students' achievement in the concept of chemical structure and bonding in chemistry, it was observed that there were no significant interaction effects among these variables. This indicated that the effects of the treatments were the same at all levels of gender and school location; that the influence of gender was the same at all levels of treatment and school location; and that the influence of school location was the same at all levels of treatment and gender.

nteraction Effects of Treatment, Gender, and School Location on Students' Retention : The findings with regard to the interaction effects of treatment by gender, treatment by school location, gender by school location and treatment by gender by school location on the students' retention of concepts on chemical structure and bonding in chemistry, it was observed that there were no significant interaction effects among these variables. This indicated that the effects of the treatments were the same at all levels of gender and school location; that the influence of gender was the same at all levels of treatment and school location; and that the influence of school location was the same at all levels of treatment and gender.

VII. CONCLUSION

Based on the findings of the study, it is hereby concluded that of the two teaching/ learning strategies investigated, blended learning is the more effective in facilitating students' academic performance in the concept of Atomic Structure in chemistry. Also, that gender had no statistically significant influence on the students' performance.

RECOMMENDATIONS

Based on the findings of this study, it is recommended that:

- Chemistry teachers should make effective use of blended learning strategy in teaching the concept of Atomic Structure in chemistry.
- Curriculum planners should ensure the incorporation of these strategies in the teaching and learning of chemistry concepts as this will help to concretize learning thereby, facilitating academic performance of students.
- Government in conjunction with other professional bodies like STAN should endeavour to organise and sponsor regular workshops, seminars and conferences to train Science teachers on the use of blended learning teaching strategy.
- Pre-Service teachers should be trained on how to develop and employ the use of blended learning teaching strategy.

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