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Blended Instructional Strategies and Performance of Senior Secondary II Students in Chemistry in Calabar Education Zone of Cross River State, Nigeria

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Abstract
The study investigated the effect of blended learning, simulation and conventional instructional strategies on performance and interest of senior secondary II Chemistry Students in Calabar education zone of Cross Rivers State, Nigeria. Three hypotheses were formulated to guide the study. The sample comprised of 150 senior secondary II students selected using purposive sampling technique. Quasi-experimental research design was used for the study; the instruments for data collection were Chemistry Performance Test (CPT) and Chemistry Interest Inventory (CII) with a reliability estimate of .78 and .83 respectively. The data were analysed using ANCOVA and Scheffe's post hoc test. The result indicates that the mean performance and interest of students taught using blended learning instructional strategy was significantly better than those taught using simulation and conventional strategies. The result also revealed no significance in the mean performance and interest scores of male and female students taught using the three strategies. It is recommended that the use of blended learning instructional strategy should be adopted and encouraged to bridge the gap between male and female performance disparity in chemistry.
Keywords: Blended, learning, simulation, conventional, instructional, strategy

Introduction
The development of any nation is a measure of her development in the area of science and technology. America, Russia, Japan and China are examples of nations which are now referred to as developed, as a result of their development in science and technology. The 21st century is characterized by a technology infused environment with a nascent generation of digitally conscious youths that are highly conversant with the various forms of electronic gadgets and tools from the Information and Communication Technology sector (ICT). Due to the rapid increase in the use of technologies in different fields in the society today, educators are getting involved in the use of computer in education because they believe it is more effective and

advantageous as an educational tool, compared with other tools. The major issue that faces science education anywhere is how science educators can provide a better and interactive educational environment and which method can lead to the attainment of this aim.

In Nigeria, chemistry is one of the important science subjects taught at the senior secondary school level. It is one of the core science subjects that students are required to pass at credit level in order to qualify for admission into tertiary institutions to pursue science-based programmes. In spite of this central and important position of chemistry among other science and related disciplines, studies revealed a continuous decline in the performance of students in chemistry at the senior secondary school certificate examination. One of the reasons for such decline is the teaching methods adopted by chemistry teachers (Adeniji, 2013). According to Obiekwe and Ngelita (2013), chemistry is an essential tool for survival in the exciting world of globalization and needs to be taught using the best method and approach to enhance optimum performance, interest and attitude towards the subject.

The conventional method of using book in teaching chemistry has limited effect on the learners who are the main player on which the whole learning operation depends. Modern trends in science teaching in meeting global best practices cannot be underestimated in today's changing world (Etiubon & Udofia, 2013). The advent of digital technology has dramatically changed the routines and practices in most areas of human existence. ICT has paved the way for accelerating a paradigm shift in the teaching and learning process. With this widespread trend, it has become paramount to address the challenges and expectations of the 21st century learners and provide them with alternative and new learning opportunities capable of responding to the learners' as well as the teachers' growing interest and attitudes in technology based learning experiences in science. The teaching and learning of chemistry in secondary schools still remains a serious problem to chemistry teachers due to its abstract nature; the continuous decline in the performance of students in senior secondary certificate examination has become worrisome; several strategies were employed to improve students' performance in the subject; among them is the use of blended learning strategy. This study seeks to identify the impact of teaching chemistry using blended learning instructional strategy on students' attitude, interest and performance in chemistry.

Blended instructional strategy, according to Connection Education (2013), is a computer –mediated instructional strategy that leverages technology and focus on the student teacher relationship to enlarge independence, engagement and achievement; it does not only include technology but real life experiences too. As the word indicates, it is a blend of teacher led instructions by face to face interactive session, web-based

assessment through feedback, reflection outcome and computer mediated instruction. It is a combination of digital, visual, e-learning and printed instructions using traditional study material. The main feature of blended learning is making the whole learning process depend on the students' interaction with computer and help them to be more creative and positive; the teacher's role is to control the workflow of the computerized science subject (Osquthrape & Graham, 2003).

Falode and Onasanya (2015) observed that the application of computer technology in classroom teaching and learning environment has shown to play significant role in enhancing teaching and learning of science subjects. Computer-based instructional strategies are considered an effective alternative to traditional teaching strategies. Today in numerous educational and training settings, interactive computer programmes are used to teach young students and adult computer literacy skills as well as provide great promise for handling functions like testing, diagnosing students' deficiencies, students' progress and providing individual schedules and study assignment.

The uniqueness of blended learning instructional strategy is present in its ability to use the refined technique from both e-learning and conventional methods; as a result this creates an opportunity to provide students with scientific material in an easy, fast and clear forms of e-learning to suit the needs of learners and nature of the tools available to connect with the learning process (Thorne, 2003). Mondal, Majumder and Mandal (2018) opined that blended learning is a pedagogical strategy for facilitating learning by skillfully blending online learning techniques such as delivery of materials through web pages, discussion boards, and e-mails with the effectiveness and socialization opportunities of face to face instruction.

Almasaeid (2014) carried out a study on the effect of using blended learning strategy on achievement and attitudes in teaching science among 9th grade students in Dubai Educational Zone. The sample comprised of 45 students from Omar Bin Al-khaHab Intermediate School. The instruments used for the study were science achievement test and questionnaire to measure students' attitude. ANCOVA and ANOVA were the statistical tools used for analysis. The result of the analysis between the use of traditional teaching method and the use of blended learning strategy indicated that the use of blended learning strategy to teach science has a positive impact on achievement, skills and attitudes. The study also revealed a high level of performance on achievement test using blended learning strategy.

In another study, Suleiman, Salaudeen and Falode (2017) investigated the effect of computer-based blended learning strategy on secondary school chemistry students' retention in individualized and collaborative learning settings in Minna, Niger State

Nigeria with a sample of 120 students. The result showed that computer-based blended learning strategy improved students' retention in chemistry in collaborative learning settings better than in individualized learning setting and in lecture method.

Conversely, Hinampas, Murillo, Tan and Layosa (2018) carried out a study on the effect of blended learning approach on students' academic achievement and practical skills in science laboratory and found out that no significant difference existed between academic achievement of students exposed to blended learning and those exposed to non-blended learning strategy.

Okore (2015) also carried out a study to ascertain the effects of instructional software package method of teaching on students' interest and achievement in chemical bonding; the study revealed that instructional software package method of teaching had significant effect on both students' interest and achievement in chemical bonding. In another study Orjika (2013) investigated the effects of computer assisted instruction package (CAIP) on secondary school students' achievement and interest in Biology. The result showed a significant effect on students' achievement and interest in Biology.

Khader (2016) carried out a study on the effectiveness of blended learning in improving students' achievement in third grade science in Bani Kennana; the result showed a statistically significant difference in the post achievement due to the teaching method in favour of the experimental group and a statistically significant difference in the post achievement due to gender in favour of males; and lack statistically significant difference in the post achievement due to the interaction between the method and gender.

The growing awareness of the contributions of chemistry to national development makes it imperative for chemistry educators to continue to find ways of giving the subject meaning and relevance among its learners by researching, advocating and employing appropriate teaching strategies for meaningful understanding and application of facts.

Research Questions

The following research questions guided the study:

1. What difference exists among the mean performance scores of students taught separation techniques using blended learning, simulation and conventional instructional strategies?
2. What difference exists among the mean interest scores of students taught separation techniques using blended learning, simulation and conventional instructional strategies?

3. What difference exists among the mean performance scores of male and female students taught separation techniques using blended learning, simulation and conventional instructional strategies?

Hypotheses

Ho1: There is no significant difference in the performance scores of students taught separation techniques using blended learning, simulation and conventional instructional strategies.

Ho2: There is no significant difference in the mean interest scores of students taught the concept of separation technique using blended learning, simulation and conventional teaching strategies.

Ho3: There is no significant difference in the mean performance scores of male and female chemistry students taught the concept of separation techniques using blended learning instructional strategy, simulation and conventional teaching strategies.

Methodology

Quasi-experimental research design was adopted for the study using a non-randomized pretest-posttest control group. The design was considered appropriate because intact classes without randomization were used for both experimental and control groups. One thousand six hundred and thirty-three (1,633) senior secondary II students offering chemistry made up the population of the study. A total of one hundred and fifty senior secondary II students in their intact classes from three selected school in Calabar education zone using purposive sampling technique was used as the sample of the study. Two schools were assigned experimental groups using blended learning and simulation and one was assigned the control group subjected to lecture method.

The instruments used for the study were Chemistry Performance Test (CPT) and Chemistry Interest Inventory (CTI). The instruments were both face and content validated and had a reliability estimate of .76 and .78 for both the performance test and interest inventory respectively. The chemistry performance test was a twenty-five multiple choice items with four response options A, B, C, D and only one correct option; each correct answer scored 4marks and zero for wrong answer. The total maximum mark for all 25 items is 100 and the minimum score is zero. The chemistry interest inventory was a 25 item interest inventory with a four point scale of strongly agree (SA), Agree (A), Disagree (D) and strongly disagree (SD) which were scored 4, 3, 2 ,1 respectively.

The researcher randomly assigned three intact classes to experimental group 1, experimental group 2 and the control group; pre-test and pre-interest scale were administered and the result used as covariate measures. The students in experimental

group 1 were taught using blended learning, those in experimental group 2 were taught using simulation and those in control group were taught using the conventional lecture method. Post-test and post-interest scales were administered after three weeks of treatment. The data collected were analysed using descriptive statistics (mean and standard deviation), Analysis of Covariance (ANCOVA) and the Scheffe multiple comparison test for post hoc analysis. All hypotheses were tested at .05 level of significance.

Presentation of results

Ho1: There is no significant difference in the mean performance scores of students taught separation techniques using blended learning, simulation and conventional instructional strategies.

Table 1: Analysis of covariance (ANCOVA) of post-test scores of students taught separation techniques using blended learning, simulation and conventional strategies with post-test as covariate

Source	Sum of squares	df	Mean square	F	P	Decision
Pre-test	461.27	1	461.27	17.02	.000*	Significant
Main effects		2	2839.80	104.79	.000*	Significant
Strategy	5679.60	3	2046.96	75.53	.000*	Significant
Model	6140.87	146	27.10			
Residual	3956.62	149	67.77			
Total	10097.49					

* = significant at P<.05 alpha

Table 2: Result of Scheffe's post HOC test for multiple comparison instructional strategies on students' performance on the concept of separation techniques

Strategy 1	Strategy 1	Mean difference (I-J)	Std. error	Sig.
Blended learning	Simulation	2.88*	1.06	.000
	Conventional	14.86*	1.06	.000
Simulation	Blended learning	-2.88*	1.06	.000
	Conventional	11.68*	1.06	.000
Conventional	Blended learning	-14.56*	1.06	.000
	Simulation	-11.68*	1.06	.000

As shown in table 1, the calculated p-value (.000) of the main effects of strategies is less than the alpha level (.05). This implies that there exists a significant difference in the mean performance scores of students taught separation techniques using blended

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learning, simulation and conventional teaching strategies; therefore the null hypothesis is rejected.

In order to ascertain the direction of significance of the teaching strategies under investigation, the post-test scores were subjected to Scheffe multiple comparison test as shown in table 2. The mean difference of students taught using blended learning and simulation strategies is 2.88, blended learning and conventional is 14.56 while simulation and conventional is 11.68. These indicate that blended learning strategy is the most effective in enhancing student's performance on the concept of separation technique followed by simulation while conventional is the least.

Ho2: There is no significant difference in the mean interest scores of students taught the concept of separation technique using blended learning, simulation and conventional teaching strategies.

Table 3: Analysis of covariance (ANCOVA) of post-test interest scores of students taught the concept of separation technique using blended learning, simulation and conventional strategies with pre-test interest scores as covariate

Source	Sum of squares	df	Mean square	F	P	Decision
Pre-test	6574.61	2	6574.61	187.28	.000*	Significant
Main effects			5674.78	161.65	.000*	Significant
Strategy	11349.56	2	5974.72	170.20	.000*	Significant
Model	17924.17	3	35.11			
Residual	5125.32	146	154.70			
Total	23049.49	149				

* = significant at P<.05 alpha

Table 4: Result of Scheffe's post HOC test for multiple comparison of instructional strategies on student's Interest on the concept of separation techniques

Strategy 1	Strategy 1	Mean different (I-J)	Std. error	Sig.
Blended learning	Simulation	3.68*	1.33	.025
	Conventional	23.84*	1.33	.000
Simulation	Blended learning	3.68*	1.33	.025
	Conventional	-20.16*	1.33	.000
Conventional	Blended learning	-23.84%	1.33	.000
	Simulation	-20.16	1.33	.000

In table 3, the calculated p-value (.000) of the main effects of strategy is less than the alpha level .05; this implies that there exists significant difference in the mean interest scores of students taught the concept of separation techniques using blended learning, simulation and conventional teaching strategies. To ascertain the direction of significance of the teaching strategies under investigation, the post-test interest scores were subjected to the Scheffe multiple comparison test as shown in table 4. The mean difference of students taught using blended learning instructional strategies and simulation is 3.68, blended learning and conventional is 23.84 while conversional and simulation is 20.16. This indicates that blended learning instructional strategy is the most effective in facilitating students' interest, followed by simulation and conventional strategy.

Ho3: There is no significant difference in the mean performance scores of male and female chemistry students taught the concept of separation techniques using blended learning instructional strategy, simulation and conventional teaching strategies.

Table 5: Analysis of covariance (ANCOVA) of performance scores of male and female students on the concept of separation techniques using blended learning, simulation and conventional strategies with post-test as covariate

Source	Sum of squares	df	Mean square	F	P	Decision
Pre-test	461.27	1	461.27	16.74	.000*	S
Main effects combined	5687.76	3	1895.92	68.81	.000*	S
Strategy	5679.60	2	2839.80	103.06	.000*	S
Gender	8.16	1	8.16	.30	.587	NS
2-ways interactions						
Strategy gender	8.16	2	4.08	.15	.863	NS
Model	6157.20	6	1026.20	37.24	.000*	S
Residual	3940.30	143	27.86			
Total	10097.49	149	67.77			

* = significant at P<.05 alpha
NS = Not significant at .05 level of significance

As shown in table 5, the calculated p-value (.587) of the main effects of gender is greater than the alpha level (.05). This implies that there exists no significant difference in the mean performance scores of male and female students taught separation techniques using blended learning, simulation and conventional instructional strategies.

Discussion of findings

The difference in the mean performance and interest scores of chemistry students taught the concept of separation techniques using blended learning, simulation and conventional teaching strategies indicated that students taught using blended learning instructional strategy performed significantly better than their counterparts taught using simulation and conventional strategies. This result agrees with Almasaeid (2014), and Suleiman et al. (2017) whose studies showed a high level of performance on achievement test using blended learning strategy.

The result also indicated that the interest of students taught using blended learning instructional strategy was significantly better than those taught using simulation and conventional teaching strategies. This result can be attributed to the use of blended learning being a way of meeting the challenges of tailoring learning and development to the needs of individuals by integrating the innovative and technological advances offered with the best of traditional learning, making difficult task easier by offering simple instructions of processes and steps that are potentially complicated, thus stimulating the interest of students towards the subject. This is in consonance with the study of Okore (2015) and Orjika (2013).

The difference in the mean performance and interest scores of male and female students taught the concept of separation techniques using blended learning, simulation and conventional strategies was not significant. This may be attributed to the fact that a good teaching method is not expected to discriminate between male and female students. This is in line with the findings of Khader (2016) whose study showed lack of statistically significant difference in the post achievement due to the interaction between the method and gender.

Conclusion

The result of this study provides empirical evidence that the use of blended learning instructional strategy enhances the performance and interest of student in separation technique; and gender does not influence students' performance in the strategies.

Recommendations

The following recommendations are made:

1. Blended learning instructional strategy should be adopted by chemistry teachers in the teaching and learning process in senior secondary schools; this could be achieved by training chemistry teachers on effective usage.
2. Blended learning strategy could bridge the gap between male and female performance disparity in chemistry. Therefore it usage should be encouraged in teaching science.

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