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# A Comparative Study of the Effectiveness of Blended Learning and Lecture Methods on Chemistry Students' Scholastic Ability in Delta State

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**ABSTRACT**

*The study investigated the scholastic ability of chemistry students in Delta State, comparing the effectiveness of blended learning and lecture methods. Three research questions were posed and three hypotheses were formulated and tested at a significance level of 0.05. A quasi-experimental design, employing a non-equivalent pre-test, post-test, control group design with a 3x2 factorial design, was utilized. The study population consisted of 29,409 Senior Secondary School II (SS II) students. A sample of 164 SS2 students was selected from three secondary schools in Delta State using purposive non-randomized sampling. Data collection utilized the Scholastic Ability Test (SAT), which demonstrated a reliability index of 0.84. Data analysis involved mean scores, standard deviations, charts, one-way Analysis of Variance (ANOVA), and independent t-tests. The study's findings indicate a significant difference in the mean scholastic ability scores of students when comparing blended learning with lecture instructional methods in chemistry. Furthermore, there was no significant difference observed in the scholastic ability between male and female chemistry students when exposed to either blended learning or lecture methods. Consequently, the study concludes that blended learning enhances the academic ability of chemistry students more effectively than traditional lecture methods in Delta State. Additionally, the study suggests that variations in academic ability are not related to gender but are primarily influenced by instructional methods. Based on these findings, recommendations include encouraging chemistry teachers to integrate blended learning strategies into their teaching practices to enhance the scholastic ability of secondary school students.*

**Keywords:** Blended Learning, Lecture Instructional Method, Sex, Scholastic Ability, Chemistry

## INTRODUCTION

Chemistry is the study of the composition, structure, and properties of matter, including the changes that matter undergoes and the related energy changes that accompany material changes. It occupies a central position amongst the scientific subjects. The usefulness of chemistry is seen vividly around us in the areas of the manufacture of textiles, fertilizers, herbicides, insecticides and fungicides. It is equally essential for the management and utilisation of natural resources; the provision of good health facilities; adequate food supply; and a favourable living environment (Babalola, 2015). The teaching of chemistry plays a crucial role in instilling scientific knowledge and fostering a science-oriented mindset among learners. This mindset, when applied in the professional sphere, contributes to the growth of individuals, society, and the overall standard of living. Consequently, the significance of chemistry knowledge and skills in the economic and industrial advancement of Nigerian society cannot be overstated. As outlined in the National Policy on Education in Nigeria, the objectives of teaching chemistry in secondary schools are multifaceted: Facilitating the transition in the application of scientific concepts and techniques acquired through integrated science (now basic science) and chemistry. Providing fundamental chemistry concepts and principles through effective content selection and sequencing. Demonstrating chemistry's interconnectedness with other scientific disciplines. Illustrating chemistry's relevance to industry, everyday life, as well as its associated hazards and benefits. Furnishing students who may not pursue higher education with a solid foundation for various future career paths (NPE, 2013). Achieving these objectives hinges greatly on the instructional strategies employed by teachers in implementing the curriculum.

Methodology plays a crucial role in teaching-learning situations, promoting or hindering students' learning. In chemistry, teachers often passively take in lessons, despite research showing successful education goes beyond just imparting knowledge. Researchers aim to find effective instructional strategies to help all students learn, ensuring self-reliance and survival in secondary schools in Nigeria and Delta State. In recent years, there has been a growing interest in alternative instructional methods, such as blended learning, to enhance the learning experience and learning outcomes for students. Blended learning integrates traditional in-person instruction with online learning materials, fostering a more flexible and interactive educational experience. Widely recognized and embraced across diverse sectors, including education, this approach combines instructor-led classroom activities with digital technology and online resources. It harmonizes face-to-face teaching with digital course components, granting students greater control over their learning journey and pace. Unlike mere duplication of content, blended learning synergizes in-person and online elements to enrich the learning process. Research suggests

that blended instruction surpasses the efficacy of solely face-to-face or online classes (Lothridge, Fox, & Eileen, 2013). Moreover, it has been shown to elevate student achievement levels, outperforming traditional face-to-face instruction (Saritepeci & Cakir, 2015).

Employing a blend of digital instruction and personalized face-to-face interaction enables students to engage independently with new concepts, thereby allowing teachers to allocate more time to provide individualized support to students requiring additional attention. Blended learning empowers students to progress at their own speed, ensuring thorough comprehension of new ideas before advancing. Within a blended learning classroom setting, learners are naturally prompted to exhibit greater autonomy, self-regulation, and independence in pursuit of academic success (Dziuban, et al., 2018). Several researchers (Sartepeci & Yldz, 2013; Ceylan & Kesici, 2017) have explored blended learning as an instructional approach, consistently yielding positive outcomes. For instance, Ceylan and Kesici (2017) demonstrated that blended learning significantly enhances academic success. Similarly, Sartepeci and Yldz (2013) found that blended learning positively influences students' active engagement in courses and boosts their motivation toward learning. A study conducted by Acelajado (2011) investigating the impact of blended learning on mathematics instruction concluded that blended learning approaches outperformed traditional lecture methods

The lecture instructional method, characterized by limited student engagement, is being supplanted by blended learning—an adaptable and interactive approach merging face-to-face teaching with online resources. This method grants students greater control over their learning pace and path, gaining traction across various sectors, notably education. Within blended learning, the integration of in-person and digital components synergizes to enrich the learning experience, transcending mere content duplication. Research suggests that blended instruction surpasses the effectiveness of solely face-to-face or online classes (Lothridge, Fox, & Eileen, 2013), fostering high levels of student achievement (Saritepeci & Cakir, 2015).

By combining digital instruction with personalized face-to-face interaction, students can independently engage with new concepts, allowing teachers to provide tailored support where needed. Blended learning accommodates individual learning speeds, ensuring comprehensive understanding before progressing. A classroom environment embracing blended learning naturally cultivates learners' autonomy, self-regulation, and independence (Dziuban, Graham, Moskal, Norberg, & Sicilia, 2018).

The traditional lecture instructional method is a time-honored approach characterized by the delivery of information primarily through lectures, with minimal student involvement. Despite its longstanding history and continued use by some educators, the lecture method remains favored for its efficiency in conveying information. It follows a structured format, where the instructor systematically presents main ideas, concepts, and key points in a logical sequence to facilitate effective information transmission. While primarily informational, the lecture method also incorporates opportunities for interactive dialogue, such as questioning, student inquiries, or group discussions, aimed at engaging students and fostering active participation.

This approach enables instructors to cover a vast amount of material within a relatively brief timeframe and present complex ideas comprehensively. However, a notable limitation of the lecture method is its potential to foster passive learning experiences among students, as it relies on information absorption without active engagement or real-life application. Additionally, it may not cater adequately to diverse learning styles, as some students may prefer hands-on, interactive learning experiences, while others may thrive in self-directed or self-paced environments.

The lecture instructional method persists as a widely adopted teaching approach owing to its straightforwardness and efficacy in disseminating information to large student cohorts. Despite its prevalence, this method does have drawbacks, such as promoting passive learning and limited interaction, yet it remains the predominant instructional approach in secondary education. Consequently, there arises a necessity to assess its impact on the scholastic abilities of chemistry students in secondary schools across Delta State, particularly in comparison to blended learning.

Existing research on the efficacy of blended learning predominantly originates from outside Nigeria, with limited exploration into its effects on students' abilities. Moreover, the few studies available have focused on subjects like social studies and mathematics, underscoring the imperative to investigate the influence of blended learning specifically on students' chemistry abilities.

Scholastic ability, denoting a student's intellectual standing, encompasses inherent qualities such as intelligence, critical thinking, and problem-solving skills, crucial for understanding and learning academic subjects. It profoundly influences academic success, shaping an individual's capacity to grasp complex concepts, retain information, employ critical thinking, and engage in autonomous learning. Furthermore, scholastic ability can influence educational and career trajectories. According to Aluko and Olorundare (2010), a student's ability reflects their capacity to learn, understand, and solve problems, with varying speeds of learning associated with different ability levels. Notably, a lower ability score doesn't necessarily predict future academic failure, as students may excel in alternative domains. However, learners with medium ability scores may exhibit reduced motivation, particularly if they lack confidence in group performance. It's noteworthy that Nigerian schools often aggregate high, medium, and low ability students within the same classroom, teaching them identical concepts without regard for individual differences (Yusuf, 2004).

Innovative instructional methods are crucial across all education levels to bolster students' abilities and achievements, as emphasized in the National Policy on Education (2018). However, it appears that many educators remain unaware of the advantages of blended learning, resulting in schools inadequately fostering students' self-awareness and ability to extract meaning from interactive content presentations (Ajaja, 2013). This study aims to bridge this knowledge gap by examining the diverse impacts of blended learning and lecture methods on chemistry students' academic performance in our local context. The research seeks to compare the effects of these instructional approaches on student ability in chemistry within Delta State and assess whether these effects are influenced by sex. Consideration of sex differences is imperative in evaluating students' academic achievements and abilities in chemistry. "Sex" refers to biological and physiological characteristics distinguishing males from females, encompassing aspects such as chromosomes, gene expression, hormone levels and functions, and reproductive anatomy. While gender is typically categorized as male or female, there are variations in biological traits and their manifestation. The key distinguishing factor between males and females is biological sex.

Numerous studies have explored sex differences in learning and students' abilities, with some suggesting that biological variations in brain structure impact learning outcomes based on gender. Typically, males exhibit a preference for intellectually and abstractly oriented concepts, while females tend to focus on practical, emotional, and personal aspects. However, findings regarding the relationship between gender and science achievement vary. While some studies found no significant correlation between gender and science performance (Amenah, 2019; Jia, Yang, Qian, & Wu, 2020), others reported males outperforming females in academic ability. Consequently, the role of gender in scholastics ability relative to instructional methods remains inconclusive, underscoring the importance of incorporating sex as a moderating variable in this study.

## Statement of the Problem

There is a growing concern regarding the selection of instructional strategies in secondary schools to address the declining trend in students' performance in chemistry. Based on the researcher's personal observations, it is evident that chemistry teachers predominantly rely on the lecture method, overlooking innovative approaches that encourage active student participation. The limited use of innovative teaching methods, such as blended learning instructional strategies, may be a key factor contributing to students' underachievement and limited ability in chemistry. Nevertheless, blended learning instructional strategies have proven effective in enhancing students' abilities and achievements across various subjects and contexts, both domestically and internationally. Reports indicate that blended learning has facilitated effective teaching in secondary schools, leading to improvements in students' scholastic abilities. However, to the best of the researcher's knowledge, the potential of blended learning instructional strategies to enhance students' scholastic abilities in chemistry among secondary school students in Delta State has yet to be empirically established. Hence, the primary objective of this study is to investigate the impact of blended learning and lecture methods on the scholastic abilities of chemistry students, considering gender differences, in Delta State.

## Research Questions

The following research questions were answered in this study:

1. Do students differ in their mean scholastic ability score based on the use of blended learning versus lecture instructional methods in chemistry?
2. Do male and female chemistry students exhibit different scholastic abilities when exposed to blended learning instructional method?
3. Do male and female chemistry students exhibit different scholastic abilities when exposed to lecture instructional method?

## Hypotheses

The following null hypotheses were tested in this study:

1. There is no significant difference in the mean scholastic ability score of students based on the use of blended learning versus lecture instructional methods in chemistry.
2. Do male and female chemistry students' mean scholastic ability scores differ when exposed to blended learning instructional method?
3. Male chemistry students' scholastic ability does not significantly differ from their female counterparts when exposed to the lecture instructional method.

## Research Method

A quasi-experimental design, non-equivalent pre-test, post-test, control group design using a 3 x2 factorial design was adopted for the study. The design has treatments (instruction) at three levels blended learning and lecture method and control(revision) group across with sex at two levels (male and female) students. The population of this study comprises a total of 29,409 Senior School II (SS II) students offering chemistry in all the government-owned secondary schools in Delta State for the 2021/2022 session. A sample of 164 SS2 students were drawn from three secondary schools in Delta State. Multi-stage sampling procedures which comprise of simple sampling technique and purposive sampling technique were employed in composing the sample for the study.

The instrument that was used for the study is the Scholastic Ability Test (SAT). the SAT was used for pretest and post test data. The consists of two sections was adapted from Thomas (2019). Section A contained instruction on the student's bio-data (sex). Section B has 40 multiple-objective test-items. The items were generated in such a way that the cognitive aspects of chemistry were included and aspects of ability test were reflected such as numerical, verbal, quantitative and spatial ability each consist 10 questions making a total of 40 multiple-objective test-items with option letters A-D in the SAT

To carry out the face validity of the Scholastic Ability Test(SAT), the researcher requested the assistance of three experts from Delta State University, Abraka. Content validity was carried out on by the use of the table of specifications. The topics that made up the CAT were adopted from the uniform scheme of work for SS II in Delta State. To determine the construct validity of the instruments, 50 copies of the SAT were produce and administered to SS II students in Benin-City, Edo State.

Data obtained was used to compute Difficulty Indices and Discrimination Indices of the items that made up the instrument. The item difficulty (P) and discriminating indices (D) were calculated for 45 items respectively on the SAT to select 40 items in the SAT. The students' sheets were re-arranged from the highest to the lowest. The upper group of 27% and lower group of 27% were selected and used for the item analysis. Items with difficulty indices ranging from 0.40 to 0.70 were included (accepted) for the final test while others below 0.30 and above 0.70 were discarded (rejected) as a result of being too difficult or too easy respectively. the value of difficulty index of the SAT lies between 0.41 and 0.64. with item number 33 having the largest value (0.64) and item number 20 having the smallest value (0.42). The item discrimination index (D) ranged from 0.25 to 1.00 and this formed the bench mark for accepting items regarding discrimination indices for the final test. The value of discrimination index (D) of the SAT lies between 0.42 and 0.86. with Item number 39 having the largest value (0.86) and item number 3 having the smallest value (0.42).

The researcher carried out the reliability test of SAT on 50 SS II students in two secondary schools in Benin-City, Edo State. Data collected through the test was used to compute the reliability of the instrument. The Kuder-Richardson formula-21 was used to compute the reliability index, which yielded 0.84. The method was considered appropriate since the test-items in the SAT are multi-choice achievement tests that are scored dichotomously (correct or wrong).

## Treatment Procedures

Two chemistry teachers were trained in blended learning for four days, two hours each day. The training covered theories, characteristics, and steps of the teaching strategy. The training manuals were developed by the researcher and other specialists, The first day was spent discussing the theories and characteristics of blended learning. On the second day, the teachers were trained using the training manuals developed by the researcher; one each for blended learning and the third and fourth day focused on practice and idea generation. The training concluded when the teachers were confident in applying the strategies effectively.

Two chemistry teachers were given extracts from Osei's New School Chemistry for Senior Secondary Schools, lesson plans for blended learning and lecture method teaching, and pre-tested with the Scholastic Ability Test two days before the treatment to ensure equivalence and identify any changes due to the treatment. This ensured that all instructional presentations followed the recommended format.

Blended learning is a teaching method where students learn selected chemistry topics in groups based on gender balance and abilities. The group is divided into 3-4 groups, with the teacher introducing the topic and presenting videos to the class. Students watch the videos in a flipped classroom, with a leader presenting a summary to the entire class. The teacher supervises the activities and provides a summary at the end of each class. In the experimental group where lecture method will be used, the teachers will present the content of the topics that will be selected to the students with the use of exposed to the conventional method where the teacher did all the talking alone from beginning to the end and there was no grouping of the students after the teacher's presentation. At the end of the eight weeks of instruction by the teacher, a post-test will be administered to the students with the same SAT that will be used during the pretest.

## Method of Data Analysis

The script containing the answers provided by the students were scored. Since the test item in the SAT is dichotomous, every correct answer was awarded one mark and every wrong answer were given zero marks, so that the maximum score for SAT was 40 marks. The total marks earned by the students were used to compute the mean ability score. The research questions were answered using mean scores and standard deviations and bar chart of the data that were obtain from the pretest and post test. Hypotheses were tested with t-test statistics at 0.05 alpha levels of significance.

**Research Question 1**

Do students differ in their mean ability score based on the use of blended learning versus lecture instructional methods in chemistry?

**Table 1**

**Comparison of The Mean(X) ability score based on the use of blended learning versus lecture instructional methods in chemistry**

| | N | Pretest | | Post Test | | Mean Gain |
|---|---|---|---|---|---|---|
| Treatment group | | $\bar{X}$ | SD | $\bar{X}$ | SD | |
| Blended learning | 48 | 9.92 | 1.30 | 33.10 | 4.64 | 23.18 |
| Lecturing method | 61 | 10.24 | 2.07 | 26.30 | 3.03 | 16.06 |
| Control (revision) Group | 55 | 10.31 | 2.09 | 14.96 | 3.36 | 4.65 |
| Total | 164 | | | | | |

Table 1 compared the mean ability score of chemistry students taught with blended learning and lecture method with those in the control group. In the table, the means of the pretest and posttest ability scores of students taught using Blended learning are 9.92 and 33.10, with standard deviations of 1.30 and 4.64, respectively with mean gain of 23.10. The means of the pretest and posttest ability scores of students taught using lecture method were 10.24

and 26.30, with standard deviations of 2.07 and 3.03 respectively with mean gain of 16.06. The means of the pretest and posttest ability scores of students the in control (revision) group were 10.31 and 14.96 with standard deviations of 2.09 and 3.36 respectively with mean gain of 4.65. The difference between the pretest and posttest mean ability scores indicates that those taught using process-oriented guided inquiry learning has the gain highest ability mean score followed by those taught with blended learning and by those taught with lecture method and the control having the least mean gain.

**Hypothesis 1**

There is no significant difference in the mean scholastic ability scores of students based on the use of blended learning versus lecture instructional methods in chemistry

**Table 2**

**ANOVA Comparison of Posttest the mean scholastic ability score of students based on the use of blended learning versus lecture instructional methods in chemistry**

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Post Ability score | Between Groups | 16815.751 | 2 | 8407.875 | 806.446 | .000 |
| | Within Groups | 1678.560 | 161 | 10.426 | | |
| | Total | 18494.311 | 163 | | | |

Level of significance=0.05

The ANOVA result (F=806.446, P≤ .05) indicated a significant difference in the mean scholastic ability score of students based on the use of blended learning versus lecture instructional methods including the control in chemistry. To determine the direction of the significant difference observed in this hypothesis, the post hoc analysis using Scheffe test was computed as shown in Table 3.

**Table 3**

**Scheffe Post – Hoc Test to Determine the Direction of Difference in mean Ability Score Among the Groups**

| (I) Treatment | (J) Treatment | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|
| Blended learning | Lecturing method | 1.81660* | .62299 | .016 |
| | Control (revision) Group | 22.40795* | .63778 | .000 |
| Lecturing method | Blended learning | -1.81660* | .62299 | .016 |
| | Control (revision) Group | 20.59136* | .60040 | .000 |
| Control (revision) Group | Blended learning | -22.40795* | .63778 | .000 |
| | Lecture method | -20.59136* | .60040 | .000 |

*. The mean difference is significant at the 0.05 level.

The post hoc analysis using the Scheffe test shown in Table 3 to determine the direction of the observed significance indicated that: (i) all the students in blended learning and lecture instructional methods groups significantly outscored those in the control group; (ii) students in the Blended Learning groups significantly scored higher in ability than those in the lecture method group.

**Research Question 2**

Do male and female chemistry students' mean scholastic ability scores differ when exposed to blended learning instructional methods?

**Table 4:**

**Comparison Between the Mean Scholastic Ability Scores of Male and Female Students Taught chemistry using blended learning.**

| | N | Pretest Test | | Post Test | | Mean Gain |
|---|---|---|---|---|---|---|
| Sex | | Mean | Std. Deviation | Mean | Std. Deviation | |
| Male | 23 | 10.09 | 1.20 | 33.48 | 3.53 | 23.39 |
| Female | 25 | 9.76 | 1.39 | 32.76 | 5.52 | 23.00 |
| Total | 48 | | | | | |

Mean difference=0.39

Table 4 revealed that the mean scholastic ability scores of males and females in blended learning group during the pretest were 10.09 and 9.76, with standard deviations of 1.20 and 1.39, respectively. Also, the mean ability scores of male and female students taught chemistry using a blended learning in Delta State during the posttest were 33.48 and 32.76. The difference between the pretest and posttest mean ability scores for the male and female students in the blended learning group was 23.39 and 23.00, respectively, with male students taught using blended learning in Delta State having a slightly higher mean ability gain than the females. To find out whether the mean difference is significant, $Ho_7$ was tested with t-test and presented in Table5 below.

**Hypotheses 2**

Male chemistry students' scholastic ability does not significantly differ from their female counterparts when exposed to blended learning instructional methods

**Table 5:**

**t-test Comparison Between the Mean Scholastics Ability Scores of Male and Female Students Taught Chemistry Using Blended Learning.**

| | Sex | N | Mean | Std. Deviation | df | t-cal. | Sig. (2-tailed) | Remark |
|---|---|---|---|---|---|---|---|---|
| Posttest | Males | 23 | 33.48 | 3.53 | 46 | | | Null hypothesis not rejected |
| | Females | 25 | 32.76 | 5.52 | | 0.53 | 0.59 | |

level of significance=0.05

Table 5 is a summary of the t-test comparing the mean ability scores of male and female students taught chemistry using blended learning. in Delta State. The table reveals that the p-value (0.59) of the calculated t-value (0.53) is greater than the level of significant of 0.05. With this result, Ho2 was not rejected. Thus, Male chemistry students' scholastic ability does not significantly differ from their female counterparts when exposed to blended learning instructional methods

**Research Question 3**

Do male and female chemistry students' mean scholastic ability scores differ when exposed to lecture instructional method?

**Table 6**

**Comparison Between the Mean Ability Scores of Male and Female Students Taught chemistry using lecture method.**

| | N | Pretest Test | | Post Test | | Mean Gain |
|---|---|---|---|---|---|---|
| Gender | | Mean | Std. Deviation | Mean | Std. Deviation | |
| Male | 32 | 10.66 | 2.52 | 27.69 | 2.72 | 17.03 |
| Female | 29 | 9.79 | 1.32 | 24.66 | 2.55 | 14.87 |
| Total | 61 | | | | | |

Mean difference=2.16

Table 6 revealed that the mean ability scores of males and females in lecture method group during the pretest were 10.66 and 9.79, with standard deviations of 2.52 and 1.32, respectively. Also, the mean ability scores of male and female students taught chemistry using a lecture method in Delta State during the posttest were 27.69 and 24.66. The difference between the pretest and posttest mean ability scores for the male and female students in the lecture method group was 7.03 and 4.87, respectively, with male students taught using in lecture method in Delta State having a slightly higher mean ability gain than the females. To find out whether the mean difference is significant, $Ho_3$ was tested with t-test and presented in Table 6 below.

**Hypotheses 3**

Male chemistry students' scholastic ability does not significantly differ from their female counterparts when exposed to the lecture instructional method.

**Table 7**

**Comparison Between the Mean Ability Scores of Male and Female Students Taught chemistry using lecture method.**

| | sex | N | Mean | Std. Deviation | df | t-cal. | Sig. (2-tailed) | Remark |
|---|---|---|---|---|---|---|---|---|
| Posttest | Males | 32 | 27.69 | 2.72 | 59 | | | Null hypothesis rejected |
| | Females | 29 | 24.66 | 2.55 | | 4.48 | 0.00 | |

Table 7 is a summary of the t-test comparing the mean ability scores of male and female students taught chemistry using lecture method in Delta State. The table reveals that the p-value (0.00) of the calculated t-value (4.48) is less than 0.05 level of significant. With this result, $Ho_3$ was rejected. Thus, there is a significant difference between the mean ability scores of male and female students taught chemistry using lecture method in Delta State.

## Discussion of Results

The results of hypothesis one testing revealed a significant disparity in the mean ability scores of chemistry students taught through blended learning versus lecture methods in Delta State. One potential explanation for this discrepancy in mean ability scores could be attributed to the instructional methodologies employed by each teaching approach. Blended learning, through its integration of multimedia resources and interactive platforms, offers students a diverse array of learning modalities. This interactive and collaborative learning environment likely fosters enhanced comprehension, thereby positively influencing the mean ability scores. This finding aligns with previous research by Siregar et al. (2019), who similarly observed that students' mathematical problem-solving abilities were superior when taught through blended learning compared to conventional methods. However, it contrasts with the findings of Adesoji (2008), who reported no significant differences in ability groupings.

Testing of hypothesis two indicates that there is no significance difference between the mean achievement scores of male and female students taught chemistry using blended learning in Delta State. The possible explanation for this finding could be that the use of blended learning enables both male and female students to leverage the internet to afford them a more personalized learning experience with increased student control over the time, place, path and/or place of his/her learning. his finding is in line with Gambari, et al., (2017) who found that blended learning enhances students' learning engagement and experience irrespective of whether they are male or female. Anari (2021) whose study showed no significant difference between the mean achievement scores of male and female students taught chemistry using blended learning. This finding aligned with Adekunle, et al., (2021) who found no statistically significant difference between male and female students' performance. The finding however disagreed with Alsalhi et al., (2021) who reported a statistically significant differences in the achievement of male and female students in the experimental group in favour of females. This finding also disagree with that of Allahnana, *et al.*, (2018). They found that male students achieved mathematics significantly better than female students when taught with blended instructional strategy.

Finding from hypothesis three showed that there is a significance difference between the mean achievement scores of male and female students taught chemistry using lecture method in Delta State. This finding may be due to in ability of the method to engage all the students in equal manner. The gap in the achievement score of male and female students taught chemistry using lecture method may not be unconnected with the transmission approach involved, where the teachers pass over their knowledge to their students. This finding is consistent with that of Ghazvini and Khajehpour (2011) who demonstrated that females outperform males in literary achievement. The disparity reported by this researcher may also be due to the use of lecture method. The finding is also consistent with Ameh (2012) found significance difference in the achievement of male and female students that were exposed to lecture method in sciences. This finding is consistent with that Kwame, et al., (2015) who found significance difference in math achievement of male and female students exposed to lecture method in favour females.

## Conclusion

The study conducted to find out if students differ in their mean scholastic ability score based on the use of blended learning versus lecture instructional methods in chemistry in Delta State. From the finding of this study, it was concluded that the application of blended learning enhances mean scholastic ability of chemistry students than the use of lecture method in Delta State. Besides it was concluded that variation in mean scholastic ability score in chemistry has nothing to do with sex but are entirely related to the instructional methods.

## Recommendations

In light of the findings of this study, the following recommendations were made:

1. Chemistry teachers should make deliberate efforts to incorporate blended learning instructional strategies into the teaching of chemistry so as to encourage active engagement in learning as well as to promote better enhance ability of secondary school students.

2. Chemistry teachers should ensure active participation of both male and female students during the teaching and learning of chemistry through the use of blended learning to enhance ability among students irrespective of sex**.**

3. In view of the fact that blended learning are more effective in teaching chemistry and enhancing students' ability than the lecture method the Ministries of Education should encourage textbook authors to incorporate practical ways of using blended learning in the teaching of chemistry concepts in secondary schools to improve students' achievement and ability.

4. Regular workshops, seminars and symposia on effective utilization of blended learning will be organized through universities for chemistry teachers in secondary schools to afford them the opportunity to learn the skills required for effective implementation of blended learning strategies during chemistry teaching.

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