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Gender Differences in the Impact of Teacher-Student Verbal Interaction Styles on Biology Performance among Secondary School Students in Niger State, Nigeria

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Abstract

This study investigated gender and interaction styles (democratic, autocratic and laissez-faire) in Biology performance among secondary school students in Niger State, Nigeria. Descriptive survey research design was adopted for the study. Two (2) research questions and two (2) corresponding null hypotheses were formulated and tested at $\alpha = 0.05$ level of significance. Twenty six thousand five hundred (26,500), Secondary School Two (SS II) students, comprising of 16,799 males and 9,701 females, and three hundred and fifteen (315) biology teachers across seven (7) Educational Zones made up the population for this study. Purposive and proportionate random sampling, cluster, systematic and stratified sampling techniques were employed in selecting four hundred and fifty (450) students (280 males and 170 females), and twenty five (25) Biology teachers as samples of the study. Students' Biology Academic Performance Test (SBAPT), Biology Teachers' Teaching Style Checklist (BTTSC), Teacher-Student Interaction Observation Schedule (TSIOS), were used as instruments to generate data for the study. All the instruments were validated and obtained reliability coefficients of 0.85, 0.76, 0.86 respectively. For the analyses, descriptive statistics (Mean and Standard Deviation) were used to answer the research questions, while inferential statistics (One-Way ANOVA, Two-way ANOVA, and Scheffe's test), were employed to test the null hypotheses. Findings showed that regardless of the patterns of teacher-student verbal interaction, male and female students exhibit the same academic performance level. Based on the findings, it was recommended among others that biology teachers should employ democratic verbal interaction pattern to improve both male and female students' academic performance in Biology.

Keywords: teacher-Student interaction, verbal interaction styles, biology performance, gender differences, secondary school students

1 Introduction

Secondary school education in Nigeria is the formal stage between basic and tertiary education, designed to prepare children for higher learning or vocational careers. It typically covers ages 11-17 and lasts six years, split into junior and senior levels. At the secondary school level in Nigeria, science subjects offered include biology, chemistry, physics, mathematics, agricultural science and others. Nnorom & Erhabor, (2019), opined that as one of the basic sciences taught in secondary schools, biology is essentially needed for a nation's technological breakthrough. According to Raiyegbemi, *et al* (2020), Biology is a unique subject that deals with living things (organisms). The biology curriculum also aims at developing broadly applicable skills, such as problem solving, communication, critical thinking and objective reasoning abilities to enable them prepare for work place and self-sustainability in the world economy. Guided by the objectives laid in the National Policy on Education, (FME, 2013), students are expected to be useful and productive members of the society.

The concept of teacher-students interaction has been variously viewed differently by authors such as Elena, (2021) and considered to be among the most important relationship a person can encounter during his life. Interaction between teacher and students is the soul of the system of education and takes place every day in the teaching and learning process. It is an important aspect of classroom instruction that enhances students' engagement, participation and academic achievement. According to Edeh (2024), teacher-students interaction during teaching-learning process could be verbal and non-verbal behaviours. Verbal interaction involves oral interaction which implies that students interact with others (including teachers) by speaking or talking in the classroom, answering and asking questions, making comments and taking part in discussions. Non-verbal interaction, on contrary, is related to behavioural responses in the classroom. These behaviours include; head nodding, hand raising, silence, touch, body gestures, and eye contacts. Within the teaching context, teacher-student verbal

interaction may be defined as the relationship that enhances teaching-learning process through speaking and conversation. It implies the use of words to convey ideas or views from the sender (teacher) to the receiver (students) who translate the words into ideas or views. . In this study, teacher-student verbal interaction is taken to be a process whereby the teacher and the students are engaged in reciprocal exchange of spoken communication during the classroom activities such as discussion, explanations, questions and feedback to enhance understanding and academic achievement. Considering teachers interaction with the students in the classroom, three (3) basic teaching or class management styles that are adopted by teachers. These teaching styles include; the democratic, the autocratic and the laissez-faire teaching styles;

The Democratic Teaching Style: Teacher involves students in decision-making and classroom activities. It encourages students' participation, collaboration and discussion. It also develops critical thinking and improves students' academic performance.

Autocratic Teaching Style: Teachers makes all decisions and controls the learning process. It focuses on discipline, authority and structured instruction. It limits creativity uses order to sometimes improve students' attitude..

Laissez-faire Teaching Style: Teacher provides minimal guidance and allows students freedom. With little structure, students learn independently. Lastly, this style can foster creativity but often results in lower performance and weak attitudes.

One of the most topical and re-occurring issue within the academics is the students' academic performance generally. It has become the major concern of Government, Organizations and Individuals' such as educators, trainers and researchers among others. Oliobi, *et al.* (2022), declared that the insignificant improvement and continual rise and fall in the percentage of students' passing biology at credit level and above call for the need to seek ways to improve students' performance in biology. Anthonysamy. Koo, and Hew (2020), defined Academic performance as students' ability to carry out academic tasks, and it measures their achievement across different academic subjects using objective measures such as final course grades and grading point average. Similarly, Udowong, Hope and Ighereno (2023), asserted that academic performance is the extent to which a student, teacher or institution has attained their short or long-term educational goals and is measured either by continuous assessment or cumulative grade point average. Despite the relevance and popularity of biology as a science subject taught in senior secondary schools in Nigeria, students' performance in the subject has not been very impressive as expected, as the percentage number of students who obtain a credit pass and above in biology is at an average level (supported by studies from researchers like Salisu (2018), Akachukwe and Okoli (2023). The West African Examination Council (WAEC) Chief Examiner's Report from 2014-2019 showed that apart from year 2012 where 35.66% of the students passed at credit and above, students who passed at credit level and above from 2014-2015 remains below 57%. From the year 2016-2019, the percentage number of students who passed at credit level and above decreased from 61.68 – 55.10.

According to Nnamani and Oyibe (2016), gender simply refers to the roles and characteristics that are socially and culturally developed to be identified with males and females in any given society. They posit that due to the overemphasis on socialization throughout childhood, gender is the result of cultural learning and lifetime socialization. Some distinctive traits are assigned to males and others to females based on gender. Males are given attributes like dominance/assertiveness, tactfulness, intellect, self-confidence, bravery, aggression, and logical thinking, among others, while females are given traits like fearfulness, submissiveness, talkativeness, and tactlessness, among others. The academic performance of male and female students in science subjects, particularly biology, has been a subject of extensive research over the years. Gender differences in academic performance have been influenced by various factors such has socialization, teaching methods, and students' attitude towards learning. In the context of secondary schools in Nigeria, there has been a growing body of literatures examining how male and female students perform in biology. A number of studies such as those of Okpala and Oyedokun (2020), found that male and female students performed similarly in biology in pre-degree programmes. Similarly, the study of Jack, and Sam (2019), on gender differences in Computer Based Test (CBT) and Paper-Based Test (PBT), found that both male and female students' performed similarly in biology. Again, Bichi (2019), observed a significant difference between the performance of male and female students' performance based on geographic location influence. Nevertheless, the academic performance of male and female students in biology in Nigerian secondary schools shows no consistent gender-based advantage. While some studies report slight male superiority, others highlight female parity or even better outcomes when learning environments are equitable. Overall, the evidence suggests that gender-neutral pedagogy and inclusive educational policies should be emphasized to ensure better learning outcomes for all students.

This study was conducted in Niger State, Nigeria, one of the largest states in the country both in landmass and population. It also represents a diverse educational setting, encompassing urban and rural secondary schools with varying resources

and student demographics. Situating the research in Niger State provides a meaningful lens for examining teacher-student verbal interaction patterns, as the state reflects many of the challenges and opportunities present in Nigerian secondary education more broadly. More importantly, this study positions Nigeria as a case study that adds to international educational research, issues such as gender disparities, classroom communication patterns or styles, gender and science learning. The study also contributes evidence in these areas from a developing country context, enriching comparative perspectives on how teacher-student interaction styles influence learning outcomes across different cultural and educational systems.

1.1 Theoretical Framework

This paper is anchored on three (3) relevant theories, and they are:

The Social Cognitive Theory by Albert Bandura (1960), the Social-Cultural Theory by Lev. Vygotsky (1978), and the Attachment Theory by John Bowlby (1969). All of these theories provide a convincing framework for this study.

1.2 Statement of the Problem

Biology stands as a foundational science subject in Nigerian secondary schools, serving as a bridge to disciplines such as chemistry, physics, agricultural science, and medicine. A strong performance in biology is not only essential for academic progression into tertiary institutions but also critical for national development in science-based fields. Even though biology is important, students still perform poorly in it. This had been shown in WAEC Chief Examiners' Reports from 2018 to 2023 and numerous scholarly studies such as (Oyovwi, 2024; Bichi *et al.,* 2017). Despite numerous educational reforms aimed at enhancing science education in Nigeria, the teaching and learning of biology in secondary schools remain largely ineffective. A major contributing factor that had attracted a lot of attention according to researchers like Varga (2017), Abdullahi (2017), Okoye and Onwuachi (2018), is the poor quality of teacher-student verbal interactions, which are often dominated by teacher-centered and non-interactive methods. These approaches hinder student engagement, foster negative attitudes toward biology, and ultimately lead to poor academic performance. Even with changes and efforts to improve teaching and learning of biology in schools, students keep performing poorly. This indicated the need to look into how teacher-student talk in class affects how students perform well. This study therefore examined the influence of different teacher-student verbal interaction styles (democratic, autocratic, and laissez-faire) performance in biology in secondary school students' in Niger State, Nigeria. By identifying interaction styles that foster improved achievement, the research aimed at contributing actionable insights toward enhancing biology education and bridging the performance gap.

1.3 Research Questions

The study was guided by the following research questions:

1. What is the difference in the mean academic performance scores of students taught biology by democratic, autocratic and laissez-faire secondary school teachers?
2. What is the difference in the mean academic performance scores of male and female students taught biology by democratic, autocratic and laissez-faire secondary school teachers?

1.4 Null Hypotheses

In other to find response(s) to the research questions, the following null hypotheses were formulated and tested at $\alpha = 0.05$ level of significance:

HO_1: There is no significant difference in the mean academic performance scores of students taught biology by democratic, autocratic and laissez-faire secondary school teachers.

HO_2: There is no significant difference in the mean academic performance scores of male and female students taught biology by democratic, autocratic and those taught by laissez-faire secondary school teachers.

2 Methodology

This research employed the descriptive survey research design which involves on-the-spot or face-to-face or direct classroom observation of biology teachers during biology lessons. The study population comprised all SS II biology students and their teachers in Niger State's seven educational zones (Minna, Suleja, Kontagora, Bida, Rijau, Kutigi, and New-Bussa). A total of 185 co-educational public secondary schools with 26,500 students (16,799 males, 9,701 females) and 315 biology teachers (203 males, 112 females) formed the population. Public schools were chosen for their common curriculum across the 25 local government areas. The study determined a sample size of 450 students (280 males, 170 females) from 26,500 using Krejcie & Morgan's (1970) table. Twenty-five co-educational schools were purposively selected across seven educational zones, with proportionate random sampling ensuring fair representation. Cluster sampling picked two intact classes per school, while systematic sampling selected 50 biology teachers for observation. Finally, stratified random sampling identified schools by teaching styles—7 Democratic, 10 Autocratic, and 8 Laissez-faire for a deeper analyses. Three (3) instruments namely; Students' Biology Academic Performance Test (SBAPT), Biology Teachers' Teaching Style Checklist (BTTSC), Teacher-Student Interaction Observation Schedule (TSIOS), were validated by experts (Senior lecturers) from Science Education Department in a University and were pilot-tested in six (6) schools of the co-educational secondary schools, of which none of the schools were among the sampled schools, but rather part of the population. This was done to refine and enhance the validity and reliability of the instruments. The refined instruments were then administered to the sampled respondents (450 students across 25 secondary schools in Niger State), to generate data for the study. Specifically, the TSIOS and BTTSC were used by researchers to observe teacher-student interactions and teaching styles.

Classroom observations were conducted in 5-minute intervals during 40-minute biology lessons. For the analyses, descriptive statistics (Mean and Standard Deviation) were used to answer the research questions, while inferential statistics (Two-way ANOVA, and Scheffe's test), were employed to test the null hypotheses. In all, the researchers obtained approval from the State Ministry of Education before the commencement of data collection. Permission was also sorted from the principals of the sampled secondary schools. Similarly, the purpose and procedures of the study were equally explained to both the participating students and teachers before the commencement of data collection. Lastly, confidentiality and anonymity were maintained throughout the study, and the information obtained from the participants were handled securely and used strictly for the purpose of this study.

3 Results

The results for the study are presented as follows:

Research Question One: What is the difference in the mean academic performance scores of students taught biology by democratic, autocratic and laissez-faire secondary school teachers?

Table **1**

Summary of Descriptive Statistics for Mean Academic Performance Scores of Students' Taught Biology by Teachers with Different Interaction Styles

Interaction Style	N	Mean	Std. Dev.	Std. Error	Lower Bound	Upper Bound	Min.	Max.
Democratic	158	14.85	0.49	0.040	14.766	14.925	14.00	16.00
Autocratic	163	12.81	0.10	0.007	12.793	12.823	12.75	13.00
Laissez-faire	129	11.84	0.03	0.005	11.833	11.853	11.82	11.99
Total	450	13.53	1.21	0.065	13.402	13.656	11.82	16.00

Min. = Minimum, Max. Maximum

Table 1 on Descriptive Mean Statistics revealed that there is significant difference in the mean academic performance scores of students' taught biology by democratic teachers and those taught biology by autocratic secondary school teachers. The computed mean academic performance scores for democratic and autocratic groups are 14.85 and 12.81 respectively, with a mean difference of 2.04 in favour of the democratic group while, for both democratic and laissez-faire groups are 14.85 and 11.84 respectively, with the mean difference of 3.01 in favour of the democratic group and similarly for autocratic and laissez-faire groups, theirs are 12.81 and 11.84 respectively, with a mean difference of 0.97, in favour of autocratic group. This implies that the mean performance scores of students taught biology by democratic teachers is higher, while

the autocratic group is next and the laissez-faire group is the least. To determine whether the mean differences are significant or not, null hypothesis one was tested as follows:

Research Question 2

What is the difference in the mean academic performance scores of male and female students taught biology by democratic, autocratic and laissez-faire secondary school teachers?

Table **2**

Summary of Descriptive Statistics for Mean Performance Scores of Male and Female Students Taught Biology by Teachers with Different Verbal Interaction Styles

Gender	Interaction Style	Mean		Std. Deviation	N
Male	Democratic	14.88		0.50	81
	Autocratic		12.82	0.10	113
	Laissez-faire	11.84		0.03	86
	Total	13.40		1.17	280
Female	Democratic	14.81		0.48	77
	Autocratic	12.80		0.09	50
	Laissez-faire	11.84		0.04	43
	Total	13.69		1.24	170
Total	Democratic	14.85		0.49	158
	Autocratic	12.81		0.10	163
	Laissez-faire	11.84		0.03	129
	Total	13.53		1.21	450

Table 2 on Descriptive statistics revealed that there is no significant difference in the mean performance scores of Male and female students taught biology by democratic, autocratic and laissez-faire secondary school teachers in Niger state. The mean scores and standard deviation were democratic: Male (14.88+0.50), Female: (14.81+0.47), autocratic: Male (12.81+0.09), Female: (12.79 +0.08), while laissez-faire: Male (11.84+0.03) and Female: (11.84 +0.03). By these mean performance scores it is obvious that male and female democratic students had the highest scores, followed by male and female Autocratic students and then the male and female Laissez-faire students had the least scores.

Hypotheses Testing

To determine whether the mean differences in the gender differences in academic outcomes across democratic, autocratic and laissez-faire styles are significant or not, the three stated null hypotheses were tested as follows:

Null Hypothesis One: There is no significant difference in the mean academic performance scores of students' taught biology by democratic, autocratic and laissez-faire secondary school teachers.

Table **3**

Summary of One-Way ANOVA Statistics for Mean Academic Performance of Students' Taught Biology by Teachers with Different interaction Styles

Variables	Sum of Squares	Df	Mean Square	F	p-value	Remark
Between Groups	689.67	2.00	344.84	3952.51	0.001	Sig.
Within Groups	39.00	447.00	0.09			
Total	728.67	449.00				

p-value < 0.05, F- computed > 2.60 at df 2, Sig. = Significant

Table 3 on summary of One-Way ANOVA for performance of students taught by different teachers with different interaction styles showed that the p-value of 0.001 is lower than the 0.05 alpha level and its computed F-value of 3952.51 is greater than the 2.60. F critical value at df 2.. To determine whether the interaction patterns are significant or not, a post-hoc test (Scheffe[ab]) was used and the result is presented in Table 4.

Table **4:**

Scheffe[a,b] Comparison Test for the Academic Performance of Students Taught Biology by Teachers With Different Interaction Styles

	Interaction Style	N	1	2	3
Scheffe[ab]	**Laissez-faire**	129	11.84		
	Autocratic	163		12.81	
	Democratic	158			14.85
	Sig.		1.000	1.000	1.000

Tables 3, 4 and One-Way ANOVA and Post-hoc (**Scheffe[a,b]**) mean comparison revealed that significant difference exist in the mean performance scores of students taught biology by teachers with different interaction styles. For the democratic and autocratic interaction groups, Table 1c on One-Way ANOVA showed 14.85 and 12.81 as their mean performance respectively, which implies that the performance of students taught biology by democratic teachers is significantly higher than those taught biology by autocratic teachers while, for democratic and laissez-faire groups, 14.85 and 11.84 represents the mean performance of the students in each group respectively, indicating that the democratic group is highly significant in the mean performance of students compared to those of laissez-faire group and for the autocratic and laissez-faire groups the mean performance of students as revealed are 12.81 and 11.84 respectively, which implies that the mean performance of students in autocratic group is highly significant than those in the laissez-faire group. Summarily, the post-hoc test revealed that the mean performance of students taught biology by democratic teachers is highly significant, while the autocratic is the next and the least among them is the laissez-faire. Therefore, the null hypothesis which states that there is no significant difference in the mean academic performance scores of students taught biology by teachers of the three interaction patterns is hereby rejected.

Null Hypothesis Two: There is no significant difference in the mean performance scores of Male and female students taught biology by Democratic, Autocratic and Laissez-faire secondary school teachers.

Table **5:**

Summary of Two-way ANOVA Statistics for Mean Performance Scores of Male and Female Students Taught Biology by Teachers with Different Verbal Interaction Styles

Source	Interaction style III Sum of Squares	Df	Mean Square	F	p-value	Remark
Corrected Model	474.462[a]	5	94.892	906.516	0.000	Sig.
Intercept	45152.948	1	45152.948	431350.308	0.00	Sig.
Gender	0.056	1	0.056	0.539	0.46	Not Sig.
Interaction style	465.823	2	232.912	2225.027	0.00	Sig.
gender * interaction style	0.071	2	0.035	0.337	0.71	Not Sig.
Error	36.009	344	0.105			
Total	64570.421	350				
Corrected Total	510.471	349				

a. R Squared = .929 (Adjusted R Squared = .928)

At the gender Vs interaction style: P=0.71 > 0.05, F computed = 0.337 < 3.00 F critical at df 2, Sig. = Significant

Table 5 on Two-Way ANOVA, revealed that there is no statistically significant difference based on gender and interaction styles, indicated by a p-value of 0.71, which is greater than 0.05. Similarly, gender alone showed no significant difference in the mean performance, with the p-value of 0.46 which is also greater than 0.05 level of significance. However, there was a significant difference in the interaction patterns, as the calculated p-value of 0.00 is lower than 0.05, indicating that there is a significant difference. To determine whether the interaction styles are significant or not, a post-hoc test (Scheffe's test) was used and the result is presented in Table 6.

Table **6**

Scheffe's Multiple Comparison Test for Mean Performance Scores of Male and Female Students Taught Biology by Teachers with Different Verbal Interaction Styles.

Gender group		N	1	2	3
Scheffe[ab]	Male Laissez-faire	86	11.84		
	Female Laissez-faire	43	11.85		
	Female Autocratic	50		12.81	
	Male Autocratic	113		12.86	
	Female Democratic	77			14.80
	Male Democratic	81			14.88
	Sig.		1.000	1.000	0.932

The Table 6 on Two-Way ANOVA statistics and the Table 2b on Scheffe's post-hoc mean comparison showed that there is no significant difference in the mean performance scores of Male and female students taught biology by democratic, Autocratic and Laissez-faire secondary school teachers in Niger State. The mean performance scores for democratic: (Male 14.88 and Female 14.80), for autocratic: (Male 12.81 and Female 12.86), while for laissez-faire, the scores were (Male 11.84 and Female 11.85). The Post-Hoc Scheffe's test showed that the mean performance of male and female students taught by the democratic teachers were significantly the highest, followed by male and female students taught by autocratic teachers while those of male and female students taught by laisser-faire teachers was the least. Therefore, the null hypothesis which states that there is no significant difference in the mean performance scores of Male and female students taught biology by democratic, Autocratic and Laissez-faire secondary school teachers in Niger State is hereby retained.

4 Discussion

The findings from hypothesis one revealed that there is no significant difference in the mean academic performance scores of male and female students taught biology by democratic, autocratic and those taught by laissez-faire secondary school teachers. The result clearly indicated that both male and female biology students taught biology by democratic teachers performed better on average than those taught by autocratic and laissez-faire teachers. The result also confirmed that when students are actively engaged in biology lessons, dialogue and collaboration emphasized in the classroom, both male and female students are positively impacted in their learning outcomes. The findings also revealed consistency in performance across gender. This is established by the near-identical mean performance scores between male (14.88) and female (14.80) students which promotes a more equitable learning environment for both genders. This is established by the near-identical mean performance scores between male (14.88) and female (14.80) students which promotes a more equitable learning environment for both genders. However, it may be noted that the use of autocratic interaction pattern can bring about mixed outcomes for both genders, yet it may still benefit some students. Knowing fully well that autocratic interaction pattern is characterized with relatively lower performance, especially among female students (12.81), it's an indication to limitations in students' engagement or creativity. Again, the little gap between gender performances suggests that autocratic pattern may not be favourable to all learners. With the use of laissez-faire interaction pattern which has the lowest performance scores across both gender (around 11.86), students may feel unsupported about learning expectations in such settings. This study revealed that when male and female students are taught biology by teachers of different interaction patterns, those taught by democratic teachers will perform well than their counterparts taught by autocratic and laissez-faire teachers.

It is apparently clear that in this study, the teacher-student verbal interaction styles have impacted variously on biology students' academic performance in secondary schools in Niger State. When students are given the opportunity to actively participate in the classroom, democratic interaction style is enhanced, active learning is encouraged, students' confidence is built, critical thinking is developed, free expression and respect of student's views and positive teacher-student relationships thrive. Therefore, to make teaching and learning of biology effective, teacher-student verbal interaction style must seriously be taken into consideration by teachers and every stakeholder, so as to improve the students' academic performance in biology among secondary schools, especially in Niger State, Nigeria.

5 Limitations and Future-Research Recommendation

The study was limited by time constraints, categorization of students into three (3) verbal interaction styles and the ravaging activities or insurgents in the state also limited the movements of the researchers in the area of coverage of the study. For

future research, the researchers suggest conducting similar study on students of higher institutions such as colleges of educations, polytechnics and universities.

6 Conclusion

Based on the findings of the study, the following conclusions are drawn:

1. Across the different teacher-student verbal interaction styles, there is no significant difference in academic performance among gender.
1. Across the different teacher-student verbal interaction styles, both male and female students exhibit the same academic performance levels.
2. Different teacher-student verbal interaction styles showed separately significant influence on academic performance in biology among male and female students'

7 Recommendations

Based on the findings of the study, the following recommendations were made:

1. Teachers to create supportive classroom environment that encourages both male and female students' classroom participation, motivation, and critical thinking, all of which are characteristic of democratic verbal interaction style in order to improve students learning outcomes in Biology.
2. Biology teachers should be motivated and encouraged through sponsorship to attend teacher training and professional development programmes such as workshops, seminars and conferences that is focused at promoting democratic verbal interaction styles to enhance students' learning outcomes, and should also help teachers emphasize strategic use of interaction styles and adapt teaching methods that will suit both cognitive and affective learning domains.
3. Schools should frequently conduct classroom observations and ask students for their thoughts, to ensure effective verbal interaction style is employed and maintained

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