INFLUENCE OF GENDER AND LEARNING STYLES ON STUDENTS' ACADEMIC PERFORMANCE IN CHEMISTRY IN ZONE A, BENUE STATE, NIGERIA

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Abstract

The study examined the influence of gender and learning styles on students' academic performance in Chemistry in Sankera axis of zone A, Benue state. Four research questions and four null hypotheses guided the study. The study adopted Ex-post facto research design. The population of the study was 2318 students (1214 boys and 1104 girls) from 38 public senior secondary schools in the three local government areas. A sample of 232 chemistry students (120 boys and 112 girls) was drawn using a multistage sampling technique. Data were collected using Chemistry Performance Test (CPT) and Students' Learning Style Inventory (SLSI) with the reliability coefficient of 0.86 using $K-R_{20}$ and 0.88 using Cronbach Alpha respectively. Research question one was answered using percentage, while research questions two to five were answered using mean and standard deviation. Null hypotheses were tested at 0.05 level of significance using One-way ANOVA for hypothesis one and t-test to test hypotheses two to four. The findings revealed that the prevailing students' learning style in Chemistry is kinesthetic learning style. There was no significant difference between the mean academic performance scores among visual, auditory and kinesthetic style learners (F=2.497, P=0.09>0.05). There was no significant difference in the mean academic performance scores between male and female visual style learners (t=1.448, df=63, P=0.15>0.05). There was no significant difference in the mean academic performance scores between male and female auditory style learners (t=1.384, df=52, p=0.17>0.05). There was a significant difference in the mean academic performance scores between male and female kinesthetic style learners in favour of the male students (t=2.700, df=111, p=0.01<0.05). It was recommended that since visual, auditory and kinesthetic learning styles were found to enhance the performance of students in Chemistry, teachers should therefore vary their teaching methods and strategies to pave way for students to use different learning styles.

Keywords: Gender, Learning Styles, performance, Chemistry and Secondary School.

Introduction

Science is a key factor in the development of any nation. It is the bedrock of technological careers. The scientific and technological development is dependent on the level of scientific knowledge a nation has (Ohwojero, 2015). It is a yardstick for measuring the rate of human development of any country. The evidence and importance of science in human development are numerous. For instance, it is primarily concerned with solution to practical problems or findings to simplified ways of doing things. Science education can therefore be beneficial in making life useful, meaningful and easy for humanity. At the secondary school level, science education is implemented through subjects such as Mathematics, Physics, Chemistry and Biology (Agogo & Otor, 2013). This study focused on Chemistry.

Occupies a central portion in sciences as well as school curriculum and plays very

important roles in scientific advancement that affects the lives of mankind (Agogo&Otor, 2013). Thus, in learning this subject, the appropriate teaching and learning styles and the gender influence are necessary for the understanding of Chemistry. But this study will focus more on the learning of Chemistry using gender and learning styles

However, available evidence on the level of performance of students in Senior School Certificate Examination Chemistry is quite low as reported by WAEC Chief Examiner's reports (2018 & 2019).The reports showed that majority of the students perform poorly in Chemistry irrespective of gender. Some of the factors for the poor performance, according to Abari, Jimoh and Maigamo (2010), include students' poor interest and perception of chemistry as a difficult subject. Teachers and students find it difficult to teach and learn Chemistry. Ndioho (2017), Agogo and Onda (2014) believe that reoccurring poor performance recorded in Chemistry is due to students' inability to understand some abstract concepts such as ionic theory, electrolysis, hydrocarbons among others in the subject. The authors also stressed that teachers and students find it difficult to teach and learn Chemistry due to ineffective pedagogical methods used by the teachers and other gender related issues.

Gender according to Wood and Eagly (20150) is a socially ascribed attribute which differentiates between masculine and feminine group. According to Dashe (2015), considerable efforts have been expended on trying to see how gender effect can be a factor in the seemingly poor performance of students in Chemistry. Unfortunately, research efforts seem not to produce definite trends from findings as they do not always agree on the magnitude and direction of gender difference in students' performances. Hence, the study investigates the influence of

gender and learning styles on academic performance of students in Chemistry among secondary school students.

Learning styles refer to the preferred way individual processes information, think and learn Ponce-Garcia and Kennison (2013). Each learner develops a preferred and consistent set of behaviors or approaches to learning. Cognitive style is a term used in cognitive psychology to describe the way individuals think, preserve and remember information. Unlike individual differences in abilities which describe performance, styles describe a person's typical mode of thinking, remembering or problem-solving.

Learning style approach to learning emphasizes the fact that individuals perceive and process information in very different ways. Thus, implies that how much individuals learn has more to do with whether or not they are smart. Every child follows its own unique way to learn and process information. Some learn by oral repetition, some learn by writing it out, while others may learn through practical works. Individuals, thus differ in the way they learn. Learning style can be described as a set of factors, behaviors and attitudes that facilitate learning for an individual in a given situation. Learning style is the characteristic cognitive, affective, social and physiological behavior that serve as relatively stable indicators of how learners perceive, interact with and respond to the learning environment. Each learner has a distinct and consistent preferred ways of perception, organization and retention. Some students are visual learners, while others are auditory or kinesthetic learners. Visual learners learn by means of charts, graphs and pictures. Auditory learners learn by listening to lectures and reading. Kinesthetic learners learn by doing. In some cases, students may combine two or three learning styles.

Purpose of the Study

The purpose of this study was to investigate the influence of gender and learning styles on academic performance of secondary school students in Chemistry. Specifically, the study sought to:

1. Identify the prevailing learning styles among Chemistry students in secondary schools
2. Find out students' performance in Chemistry among visual, auditory and kinesthetic learning.
3. Determine students' performance in Chemistry between male and female visual style learners.
4. Ascertain students' performance in Chemistry between male and female auditory style learners.
5. Determine students' performance in Chemistry between male and female kinesthetic style learners.

Research Questions

The following research questions guided the study:

1. What proportion of Chemistry students in secondary schools are visual, auditory and kinesthetic learners?
2. What is the difference in the mean academic performance scores among visual, auditory and kinesthetic style learners?
3. What is the difference in the mean academic performance between male and female visual style learners?
4. What is the difference in the mean academic performance scores between male and female auditory style learners?
5. What is the difference in the mean academic performance scores between male and female kinesthetic style learners?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

1. There is no significant difference in the mean academic performance scores among visual, auditory and kinesthetic styles learners.
2. There is no significant difference in the mean academic performance scores between male and female visual style learners.
3. There is no significant difference in the mean academic performance scores between male and female auditory style learners.
4. There is no significant difference in the mean academic performance scores between male and female kinesthetic style learners.

Research Method

Ex Post Facto research design was used for this study. According to Agogo and Achor (2019), ex-post facto design is appropriate where it is not possible for the researcher to directly manipulate the independent variable. The design is deemed suitable because the researcher cannot manipulate the variable which includes students' learning styles, gender and students' performance. These reasons justify its use for the study.

The target population consists of all the senior secondary Chemistry students in Logo, Ukum and Katsina-Ala Local Government Areas. A total of 2318 students, that is, 1214 boys and 1104 girls from the 38 public senior secondary schools in the three local government areas constituted the population of this study. A sample of 232

chemistry students (120 boys and 112 girls) constitutes the sample. Multistage sampling technique was used.

The data collected were analyzed with respect to the order of the research questions and hypotheses formulated for the study. Research question one was answered using percentage, while research questions two to six were answered using mean and standard deviations. The null hypotheses number two, three and four were tested using inferential statistics of independent t-test at0.05 level of significance, while the null hypothesis number one was tested using One-way Analysis of Variance (ANOVA) at same level of significance. The justification for the choice of One-way ANOVA was based on its assumption to test three independent categorical groups which in this study are

Auditory, Visual and Kinesthetic learning style groups, while the choice of independent T-test was based on the assumption that it is more suitable to test the difference between two independent groups (male and female).

Results

Data were presented, analyzed and interpreted based on the research questions and hypotheses. The decision rule for the null hypotheses was that if the p-value is less than or equal to 0.05 ($p<0.05$), the null hypotheses were rejected. On the other hand, if the p-value is greater than 0.05 ($p>0.05$), the null hypotheses were not rejected.

Research Question 1: What proportion of secondary school students offering Chemistry are visual, auditory and kinesthetic learners?

Table 1: Frequency and Percentage Proportion of Secondary School Students offering Chemistry that is Visual, Auditory and Kinesthetic Style Learners.

Learning Style	Number of Students	Percentage Proportion of Students (%)
Visual	65	28.02
Auditory	54	23.27
Kinesthetic	113	48.71
Total	232	100.00

Table 1 shows the frequency (number) and percentage proportion of secondary schools students offering Chemistry that is visual, auditory and kinesthetic learners. The table shows that out of 232 students offering Chemistry, 65 students representing 28.02% are visual learners, 54 students representing

23.27% are auditory learners and 113students representing 48.71% are kinesthetic learners.

Research Question 2: What is the difference in the mean academic performance scores among visual, auditory and kinesthetic style learners?

Table 2: Mean and Standard Deviation Scores Difference among Visual, Auditory and Kinesthetic Style Learners.

Learning Style	N	$\bar{x}$	δ	Mean difference b/w Visual and Auditory learners	Mean difference b/w Kinesthetic and Auditory learners	Mean difference b/w Kinesthetic and Visual learners
Visual	65	33.05	11.04			
Auditory	54	31.70	10.04	1.35	3.72	2.37
Kinesthetic	113	35.42	10.73			

Table 2 shows the mean scores for visual, auditory and kinesthetic style learners as 33.05, 31.70 and 35.42 with the standard deviation scores of 11.04, 10.04 and 10.73 respectively. The mean difference between the visual and auditory style learners is 1.35 in favour of the visual style learners, while the mean difference between the auditory and kinesthetic style learners is 3.72 in favour of the kinesthetic style learners and then the mean difference between the visual and kinesthetic style learners is 2.37 in favor of the kinesthetic style learners. The standard deviation scores of the three learning styles which are 11.04, 10.04 and 10.73 indicate that the auditory learners are more homogeneous than the visual and kinesthetic learners.

Research Question 3: What is the difference in the mean academic performance scores between male and female visual style learners?

Table 3: Mean and Standard Deviation Scores between Male and Female Visual Style Learners.

Sex	N	$\bar{x}$	δ	Mean difference
Male	40	34.60	10.91	
				4.04
Female	20	30.56	10.99	

Table 3 shows the mean and standard deviation scores of male and female visual style learners as 34.60 and 30.56 with the standard deviation scores of 10.91 and 10.99 respectively. The mean difference between male and female visual style learners is 4.04 in favour of the male visual style learners. The standard deviation scores of 10.91 and 10.99 indicate that, the male visual style learners are more homogenous than the female visual style learners.

Research Question 4: What is the difference in the mean academic performance scores between male and female auditory style learners?

Table 4: Mean and Standard Deviation Scores between Male and Female Auditory Style Learners.

Sex	N	$\bar{x}$	δ	Mean difference
Male	17	34.47	9.99	
				4.04
Female	37	30.43	9.95	

Table 4 shows the mean and standard deviation scores of male and female auditory style learners as 34.47 and 30.43 with the standard deviation scores of 9.99 and 9.95 respectively. The mean difference between male and female auditory style learners is 4.04 in favour of the male auditory style learners. The standard deviation scores of 9.99 and 9.95 indicate that, the male auditory style learners are more heterogeneous than the female auditory style learners.

Research Question 5: What is the difference in the mean academic performance scores between male and female kinesthetic style learners?

Table 5: Mean and Standard Deviation Scores between Male and Female Kinesthetic Style Learners.

Sex	N	$\overline{x}$	δ	Mean Difference
Male	63	37.78	10.58	
				5.34
Female	50	32.44	10.25	

Table 5 shows the mean and standard deviation scores of male and female kinesthetic style learners as 37.78 and 32.44 with the corresponding standard deviation scores of 10.58 and 10.25 respectively. The mean difference between male and female kinesthetic style learners is 5.34 in favour of the male kinesthetic style learners. The standard deviation scores of 10.58 and 10.25 indicate that, the male kinesthetic style learners are more heterogeneous than the female kinesthetic style learners.

Testing of Null Hypotheses
The following null hypotheses were formulated and tested at 0.05level of significance.
Hypothesis 1: There is no significant difference in the mean academic performance scores among visual, auditory and kinesthetic style learners.

Table 6: ANOVA of the Difference between the Mean Academic Performance Scores of Visual, Auditory and Kinesthetic Style Learners

Source	Type III Sum of Square	Df	Mean Square	F	Sig.	Partial Eta Square
Corrected Model	567.514[a]	2	283.757	2.497	0.085	0.021
Intercept	234679.607	1	234679.607	2064.955	0.000	0.900
Learning Styles	567.514	2	283.757	2.497	0.085	0.021
Error	26025.572	229	113.649			
Total	293020.000	232				
Corrected Total	26593.086	231				

A.R Squared=.021 (Adjusted R Squared=0.013)

Table 6 shows that $F_{(2,229)}$ = 2.497; P =0.09> 0.05. Since P-value is greater than 0.05, it means there is no significant difference between the mean academic performance scores of visual, auditory and kinesthetic style learners. Therefore, the null hypothesis was not rejected. The partial eta square of 0.021 was obtained for the learning

styles. This means that 2.1% of performance score of students in Chemistry can be attributed to the combined learning styles. Thus, the implication is that based on evidence from data analysis, there is no significant difference between the mean performance scores among students of visual, auditory and kinesthetic learning styles.

Hypothesis 2: There is no significant difference in the mean academic performance scores between male and female visual style learners.

Table 7: t-test of the Mean Academic Performance Scores between Male and Female Visual Style Learners.

Sex	n	$\overline{x}$	δ	t	p-value	df	Decision
Male	40	34.60	10.91	1.448	.152	63	Not Sig.
Female	25	30.56	10.99				

Table 7 presents the summary of t-test analysis of mean academic performance of male and female visual style learners. The t-test result reveals that there is no significant difference in the mean academic performance scores between male and female visual style learners (t=1.448, df=63, p=0.15>0.05). The null hypothesis was therefore not rejected. This implies that there is no significant difference in the mean academic performance scores between male and female visual style learners.

Hypothesis 3: There is no significant difference in the mean academic performance scores between male and female auditory style learners.

Table 8: t-test of the Mean Academic Performance Scores between Male and Female Auditory Style Learners.

Sex	n	$\overline{x}$	δ	t	p-value	df	Decision
Male	17	34.47	9.99	1.384	.172	52	Not Sig.
Female	37	30.43	9.95				

Table 8 presents the summary of t-test analysis of mean academic performance of male and female auditory style learners. The t-test result reveals that there is no significant difference in the mean academic performance scores between male and female auditory style learners (t=1.384, df=52, p=0.17>0.05). The null hypothesis was therefore not rejected. This implies that there is no significant difference in the mean academic performance scores between male and female auditory style learners.

Hypothesis 4: There is no significant difference in the mean academic performance scores between male and female kinesthetic style learners.

Table 9: t-test of the Mean Academic Performance Scores between Male and Female Kinesthetic Style Learners.

Sex	n	$\overline{x}$	δ	t	p-value	df	Decision
Male	63	37.78	10.584	2.700	.008	111	Sig.
Female	50	32.44	10.248				

Table 9 presents the summary of t-test analysis of mean academic performance of male and female kinesthetic style learners. The t-test result reveals a significant difference in the mean academic performance scores between male and female kinesthetic style learners (t=2.700, df=111, p=0.01<0.05). The null hypothesis which stated that there is no significant difference in the mean academic performance scores between male and female kinesthetic style learners was therefore rejected. This implies that there is a significant difference in the mean academic performance scores between male and female kinesthetic style learners in Chemistry in favour of the male students.

Discussion of Findings
This study investigated the influence of gender and learning styles on academic performance of secondary school students in Chemistry in Sankera axis of Zone A Area of Benue State, Nigeria. The discussion of findings was strictly based on the variables of the study which were guided by research questions and hypotheses.

The study identified the prevailing learning styles among visual, auditory and kinesthetic learners in secondary schools. The finding of the study reveals that the prevailing students' learning style in Chemistry is kinesthetic learning style. This is so because Chemistry is a practical subject (hands-on-activity subject). It demands learning by doing whereby students are allowed to carry out series of practicals in the laboratory in order to discover the facts. This finding agreed with Rajshree (2013) who found kinesthetic learning style to be the most preferred learning style for students. The finding also corroborates Abidin, Razae, Abdullah and Sigh (2011) who found that kinesthetic learning style was the most preferred students learning style. Similarly, the finding agrees with Nazir, Al-Ansari and Farooqi (2018)

who found kinesthetic learning style as having the highest proportion. The similarity in the finding between the previous and the current studies could be that Chemistry is a practical subject and it demands hands-on-activities. Another reason for the similarity in the finding between the previous study and the present study could be due to same instruments used by both the previous and the present studies.

Findings reveal that there is no significant difference between the mean academic performance scores of visual, auditory and kinesthetic style learners. This finding implies that the three learning styles are very effective for the learning of Chemistry. It therefore means that the three learning styles when used will produce same result. This finding supports Adaugo and Maxwell (2017) who conducted a study on learning styles and academic performance of junior secondary school students in Rivers State and found no significant difference in the mean academic performance scores among visual, auditory and kinesthetic style learners. The finding disagreed with Abidin, Razae, Abdullah and Sigh (2011) who found a significant difference among kinesthetic, visual and auditory style learners. The difference in the finding between the present study and that of Abidin, Razae, Abdullah and Sigh (2011) can be attributed to the differences in the research design, instrument for data collection and method of data analysis used.

Findings reveal that there is no significant difference in the mean academic performance scores between male and female visual style learners. This finding implies that both the male and female visual style learners performed equally. It therefore means that visual learning style enhanced equal performance of male and female students in Chemistry. This finding is in line with Nazir,

Al-Ansari and Farooqi (2018) who investigated the influence of gender, class year, academic performance and paternal socio-economic status on learning styles preferences among dental students and found no significant difference between learning styles and students' academic performance. The finding also corroborates Munir, Ahmad, Hussain and Ghani (2018) who investigated the relationship between learning styles and academic achievement of secondary school students and found no significant difference between learning styles and students' academic achievement. In addition, the finding agrees with Choudhary, Dullon and Tandon (2011) who studied gender difference in learning styles preference of first year medical students and found no significant mean performance difference between male and female visual style learners. The similarity between the present and the previous studies could be attributed to the choice of same.

The findings reveal that there is no significant difference in the mean academic performance scores between male and female auditory style learners. This finding agrees with Munir, Ahmad, Hussain and Ghani (2018) who found no significant relationship between learning styles and students' academic performance. The similarity between the previous and the present studies can be attributed to the same instrument used and same method of data analysis employed. However, the current finding disagreed with Manochehr (2015) who found a significant difference in the mean achievement scores between male and female students in favour of the male students. The variation in the finding between the previous study and the current study could be due to the differences in the instrument used for data collection as well as the method of data analysis employed.

The findings revealed that there is a significant difference in the mean academic performance scores between male and female kinesthetic style learners. This finding implies that kinesthetic learning style is gender sensitive and as such favors male students more than their female counterparts in Chemistry. The finding is in line with Munir, Ahmad, Hussain and Ghani (2018) who investigated the relationship between learning styles and academic achievement of secondary school students and found a significant difference in the mean academic performance of students between male and female kinesthetic style learners. The similarity in the finding between the previous and the current studies could be due to the same instrument used for data collection and same method of data analysis used. The study also corroborates Manochehr (2015) who found that male students performed higher than their female counterparts in the study of the influence of learning styles and students' academic achievement.

Conclusion
Based on the findings of this study, it was established that the prevailing learning style in Chemistry is Kinesthetic learning style. It was established that visual, auditory and kinesthetic learning styles enhance the academic performance of students in Chemistry. It was concluded that visual and auditory learning styles are not gender sensitive because they enhances equal performances of both male and female students in Chemistry. However, kinesthetic learning style was found to be gender sensitive as it favours male students more than their female counterparts in Chemistry.

Recommendations
The following recommendations were made in the light of the findings of this study:
1. Teachers should therefore vary their teaching methods and strategies to pave

way for students to use different learning styles.

2. The visual learning style and the auditory learning style are not gender sensitive.
3. Female pupils should, as a matter of importance, familiarize themselves with kinesthetic learning style. This is because Chemistry as a practical subject cannot be taught without using hands-on activities which is same as kinesthetic learning style.
4. Chemistry students should have knowledge of their preferred learning style.

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