

IMPACT OF VISUAL, AUDIO, KINESTHETIC (VAK) TEACHING STRATEGY ON PERFORMANCE IN CHORDATES AMONG STATE COLLEGES OF EDUCATION BIOLOGY STUDENTS IN NORTH-WEST, NIGERIA

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Abstract

This study investigated the impact of visual, audio and kinesthetic (VAK) teaching strategy on performance in chordates among colleges of education students in north-west, Nigeria. The study was guided by two objectives, research questions and hypotheses. Quasi experimental pre-test post-test control group design was adopted for the study. The population for this study was made up of 2641 NCE II, (1932 male and 709 female) Biology students from seven state colleges of education in north-west Nigeria. A sample of 143 participants comprising of 85 male and 58 females were randomly selected for this study. Chordates Concepts Performance Test (CCPT) was used as instrument for data collection. The instrument yielded reliability of 0.70. The research questions were analyzed using mean scores and standard deviation. Similarly, the hypotheses were tested using ANCOVA and Scheffe's test. The findings of the study show that visual, audio and kinesthetic teaching strategy enhances performance in chordates. Based on this, it was concluded that NCE Biology students learn chordates concepts better when instruction method matches students' teaching/learning strategy. It is therefore recommended that students' teaching/learning strategy should be considered when teaching chordates concepts and teachers should be trained and re-trained on the use of visual, audio and kinesthetic VAK teaching strategy in teaching chordates concepts.

Keywords: visual, audio, kinesthetic, chordates, performance, biology

Introduction

Global trends in teaching and class room management have reflected significant increase in student population, which in turn made modern science class rooms more diverse. This creates a challenge that is not only with oversized classes; but with students of varying abilities who differ in the ways they prefer to acquire information. Also, the inclusion of students from diverse cultural background, varying interest, teaching strategy, experiences, strengths and needs compel educators to re-look at their instructional practices with a view to devising a better approach to teaching and learning that would give students multiple options for taking in information and making sense of ideas (Subban, 2016). The researcher assumes

that adopting VAK teaching strategy in science delivery may arrest the fore mentioned anomalies to science education in general and Biology in particular.

Visual, Auditory, kinesthetic teaching strategy (VAK) refers to the methods and approaches used by educators to convey information. It was proposed by Neil Fleming. According to Fleming, information should be presented using three styles namely: visual, auditory and kinesthetic (Fleming, 2006 as cited in Aminu, 2015). Fleming asserts that the use of VAK in pedagogy allows teachers to prepare classes that address each of the three areas. It was believed that the more a student is able to learn through a combination of all the modalities such as visual, auditory and kinesthetic, the more embedded the learning will be (Aminu, 2015). It's more of a multisensory strategies that Combine visual, auditory, and kinesthetic elements, using multimedia resources, incorporating real-world examples, providing choices and autonomy, encouraging reflection and self-assessment, using technology to enhance learning, incorporating games and simulations.

Understanding VAK teaching strategy can help improve academic performance as revealed by different researches: Aminu (2019), different students use different styles of learning and acquiring knowledge from various sources during their learning journey. Learning strategies are diverse among different students, with a preference for a certain sensory mode to receive and process that acquired information. Thus, identifying learning strategies among different students is essential, helping students try to strengthen their preferred teaching/learning strategy and improve other non-preferred teaching/learning strategies and improve performance.

Academic performance is individual inherent potential in terms of intelligence combined with other sociological factors. Crowd (2021), submitted that academic performance is process of measuring the student auxiliary and terminal performance during and at the end of instructions. For the purpose of this study academic performances were based on the scores students will obtained following the administration of the performance test adopted by the researcher. For decades, researchers and teachers made concerted efforts to improve performance in teaching and learning of biology. For instance, Allahoki (2017) and Oyarole (2020) assessed students' performance in chordate at NCE level in North-West Nigeria using active learning methods but found fluctuations among the students over the years. It was observed that teaching methods and strategies have relatively different effectiveness on students' academic performance, and the problem of poor academic performance among students in Biology is attributed to poor instruction. According to Bichi (2021) and Usman (2018), persistence of poor performance is directly linked to over use of lecture method.

The challenge is how to diagnose why individual students are able or unable to learn, and searching for appropriate framework that support them to learn. To that effect this study suggested that an effective means to reach all learners is (VAK) teaching styles. Understanding VAK styles can help improve educators and trainers create more inclusive and effective learning environments, but it's crucial to avoid gender-based assumptions and instead focus on individual learning preferences (VAK). Jiya (2018) suggests that males tend

to be more visual and kinesthetic learners, with a slight preference for visual learning. Females, tend to be more auditory and visual learners, with a slight preference for auditory learning. However, it's essential to note that, Individual teaching strategy can vary widely, regardless of gender. Many people are multimodal learners, using a combination of VAK styles. Teaching strategy preferences can change over time and with experience. Thus, this research is all out to find out and investigate the impact of VAK teaching strategy on academic performance, attitude and emotional intelligence of NCE Biology students based on gender.

Statement of the Problem

Biology is one of the cantilever for technological and scientific development of all nations. Ideally Biology course is a subject that is student friendly in the colleges as it is a core course at secondary level of education for both art and science classes. Despite the importance of biology education, NCE students continue to exhibit poor performance, negative attitudes towards science, and inadequate emotional intelligence, hindering their academic success and future careers in science-related fields. The teaching of biology, particularly Chordates, poses significant challenges to students due to its complex concepts and abstract nature. Moreover, ineffective teaching methods lead to poor academic performance in Chordates Biology. Students exhibit negative attitudes towards science, affecting their motivation and interest. Emotional intelligence deficits hinder students' ability to cope with academic pressures.

It has been observed by the researcher that, the incessant poor performance of students in Biology (chordates) examinations at the colleges of education in the North-west Nigeria vindicates that students find chordate concepts in Biology difficult. Records and documents appraised by the researcher as seen in appendix A and B respectively. To expose learners to the aspects of chordate education, chordate was made a cognate course in Biology curriculum for NCE students at 200 levels. However, students' poor performance in chordate is forming a great barrier towards realizing the desired goal of teaching chordate and Biology at large.

Objectives of the Study

1. Determine the impact of VAK teaching strategy on the student's performance in chordate concept at NCE level.
2. Find the impact of VAK teaching strategy on the male and female student's performance in chordate concept at NCE level.

Research Questions

The following questions were formulated for the study:

1. What is the difference between the mean performance scores of NCE biology students taught chordate concepts using VAK teaching strategy and those taught with lecture method?
2. What is the difference between the mean performance scores of NCE biology students taught chordate concepts using VAK teaching strategy based on gender?

Hypotheses

H₀₁: There is no significant difference between mean scores of Biology students' academic performance taught using VAK teaching strategy and those taught using lecture method.

H02: There is no significant difference between mean scores of male and female students' academic performance taught using VAK teaching strategy.

Methodology

The study adopted a pretest, posttest and control group's quasi-experimental design utilizing intact classes, which do not allow for the randomization of subjects. Quasi experimental design (QED) of the pretest posttest and control group type in this study, aims to establish a cause-and-effect relationship between an independent variables, VAK teaching strategy and dependent variables, performance. The design involved four groups; three experimental and one control. Fleming VAK teaching strategy indicators was used in classifying the participants in to three groups; visual, audio and kinesthetic learners. A pretest was administered at the beginning of the research to determine if the samples are not different significantly in their ability level before treatment. The three experimental groups (visual, audio and kinesthetic learners respectively) are exposed to VAK teaching strategy, while control group was expose to lecture method.

The population for this study is made up of 2641 NCE II, (1932 male and 709 female) Biology students from seven state colleges of education in north-west, Nigeria. A sample of 143 participants comprising of 85 male and 58 females was randomly selected for this study. Randomly four schools were drawn out of seven by simple balloting method, and using hat draw three schools were assigned in to experimental and one school as control. Participants in the experimental groups are purposely selected using visual, audio and kinesthetic (VAK) teaching indicator. Chordates Concepts Performance Test (CCPT) was adapted from standardized NCE first semester past question papers (2019-2023) by the researcher to measure academic performance in chordates Biology. The test is made up of 30 multiple choice objectives items with options A-E, one of which is the correct answer and the other four were distracters. Each correct option attracts one mark and any incorrect answer attract a mark of zero 0. Thus, the minimum and maximum mark obtainable by a respondent are zero 0 and 30 respectively. The research questions were analyzed using mean scores and standard deviation. Similarly, the hypotheses were tested using ANCOVA and Scheffe's test.

Results

Research Question One: What is the difference between the mean performance scores of NCE biology students taught chordate concepts using the VAK teaching strategy and those taught with the lecture method?

Table 1: Mean and Std deviation of students' performance in VAK and conventional groups

Group	N	Mean	Std. Deviation
Visual	35	23.09	3.052
Audio	36	22.94	3.338
Kinestatic	35	22.14	2.982
Conventional	37	17.32	3.552

Table 1 presents the descriptive statistics of students' posttest scores across the four instructional groups, revealing clear differences in performance. Students in the visual group recorded the highest mean score (M = 23.09, SD = 3.05), closely followed by those in the audio

group (M = 22.94, SD = 3.34). The kinesthetic group also performed relatively well with a mean score of 22.14 (SD = 2.98), though slightly lower than the visual and audio groups. In contrast, the conventional group had the lowest mean score (M = 17.32, SD = 3.55), which was considerably below the other three groups. Overall, the combined mean score for all participants was 21.33 (SD = 4.01). These results suggest that students exposed to innovative instructional strategies (visual, audio, and kinesthetic) performed better than those taught using the conventional method, with the visual strategy proving to be the most effective, followed closely by the audio and kinesthetic approaches.

Hypothesis One: There is no significant difference between the mean scores of Biology students' academic performance when taught using the VAK teaching strategy and those taught using the lecture method.

Table 2: ANCOVA of students' performance taught using VAK and those taught using the conventional method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	818.529 ^a	4	204.632	19.302	.000
Intercept	12896.573	1	12896.573	1216.472	.000
Pretest	.002	1	.002	.000	.989
Group	765.266	3	255.089	24.061	.000
Error	1463.024	138	10.602		
Total	67334.000	143			
Corrected Total	2281.552	142			

Table 2 Analysis of Covariance (ANCOVA) statistics showed that significant differences exist in the mean posttest achievement scores of students taught biology concepts using different instructional strategies (visual, audio, kinesthetic, and conventional). This is because the P-value for the treatment group was 0.001, which is less than the 0.05 alpha level of significance. The P-value for the pretest was 0.989, which is greater than the 0.05 level, indicating that students' entry performance had no significant effect on their posttest achievement. The corrected model was also significant with a P-value of 0.001, further confirming the overall influence of instructional strategies on students' performance. Therefore, the null hypothesis, which states that there is no significant difference in the mean achievement scores of students taught with visual, audio, kinesthetic, and conventional methods, is hereby rejected.

Table 3: Post Hoc (pairwise comparisons) of students’ performance in VAC and conventional groups

(I) Group	(J) Group	Mean Difference (I-J)	Sig. ^b	Decision
Visual	Audio	.142	.855	Not Sig.
	Kinestatic	.940	.245	Not Sig.
	Conventional	5.759*	.000	Sig.
Audio	Visual	-.142	.855	Not Sig.
	Kinestatic	.798	.328	Not Sig.
	Conventional	5.617*	.000	Sig.
Kinestatic	Visual	-.940	.245	Not Sig.
	Audio	-.798	.328	Not Sig.
	Conventional	4.819*	.000	Sig.
Conventional	Visual	-5.759*	.000	Sig.
	Audio	-5.617*	.000	Sig.
	Kinestatic	-4.819*	.000	Sig.

Table 3 presents the pairwise comparisons of the adjusted posttest mean scores showed that there was no significant difference between students taught with the visual and audio strategies ($p = .855$), between visual and kinesthetic strategies ($p = .245$), and between audio and kinesthetic strategies ($p = .328$). This indicates that these three innovative methods produced comparable effects on students’ performance. However, each of the three experimental groups (visual, audio, and kinesthetic) performed significantly better than the conventional group. Specifically, the mean difference between visual and conventional was 5.76 ($p < .001$), between audio and conventional was 5.62 ($p < .001$), and between kinesthetic and conventional was 4.82 ($p < .001$). These values were all significant at the 0.05 alpha level.

Research Question Two: What is the difference between the mean performance scores of NCE biology students taught chordate concepts using the VAK teaching strategy based on gender?

Table 4: Mean and standard deviation of male and female students’ performance in chordate

Gender	N	Mean	Std. Deviation
Male	80	21.27	3.981
Female	63	21.40	4.074
Total	143	21.33	4.008

Table 4 presents the descriptive statistics of students’ posttest scores by gender, showing that male students had a mean score of 21.27 (SD = 3.98, N = 80), while female students had a mean score of 21.40 (SD = 4.07, N = 63). The overall mean score for all participants was 21.33 (SD = 4.01, N = 143). The closeness of the mean scores between male and female students suggests that both groups performed almost equally when taught chordate concepts using the VAK teaching strategy, with females having a very slight advantage over males.

Hypothesis Two: There is no significant difference between the mean scores of male and female students' academic performance taught using the VAK teaching strategy.

Table 5: ANCOVA of male and female performance in chordate using VAK

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	55.064 ^a	2	27.532	1.731	.181
Intercept	13053.483	1	13053.483	820.794	.000
Pretest	54.541	1	54.541	3.429	.066
Gender	1.800	1	1.800	.113	.737
Error	2226.489	140	15.903		
Total	67334.000	143			
Corrected Total	2281.552	142			

Table 5 presents the Analysis of Covariance (ANCOVA) statistics showed that no significant difference exists in the mean performance scores of NCE Biology students taught chordate concepts using the VAK teaching strategy based on gender. This is because the P-value for gender was 0.737, which is greater than the alpha level of significance of 0.05. The P-value for pretest was 0.066, which is also greater than 0.05, indicating that the covariate had no significant influence on students' posttest achievement. The corrected model was not significant with a P-value of 0.181, which is higher than 0.05. Therefore, the null hypothesis, which states that there is no significant difference in the mean performance scores of NCE Biology students taught chordate concepts using the VAK teaching strategy based on gender, is hereby retained.

Discussion of Findings

Finding of this study revealed a significant difference in the academic performance of students taught using the visual, audio, and kinesthetic (VAK) strategies compared to those taught using the conventional lecture method. The visual strategy produced the highest mean score, followed by audio and kinesthetic, while the conventional group recorded the lowest. This finding supports the notion that multi-sensory instruction enhances learning outcomes as proposed by Fleming and Mills (2006), who emphasized that students learn more effectively when teaching engages multiple senses. Similarly, Adebayo and Adeoye (2017) found that the use of visual and auditory aids in science instruction significantly improved students' achievement compared to traditional lecture methods. Since the experimental group performed significantly better, it implies that using VAK teaching strategy in teaching NCE Biology students improves their performance. The result confirms earlier findings of (Hidayatullah, 2024, Shejma, 2023, Diane, 2019, Maria, 2022, Eligbo, 2022, Dewi, & Augstina 2023,

Dharmayanti, 2023, Yuyun, 2021, Suyitno, 2021 Subuh, 2021, Nur, 2020 & Abdullah (2019) that students exposed to teaching method using VAK teaching strategy performed significantly better in the experimental groups than those in the control group .

The study contradicts that of Yudi (2019) and Sahlan (2020) who found no significant difference in the mean performance scores of students in the experimental and control group when taught with VAK teaching strategy. The study also showed that NCE Biology students in the experimental group taught with VAK teaching strategy performed better than those in the control group taught with lecture method. The result implies that integrating VAK strategies into Biology instruction can substantially improve students' understanding and retention of complex concepts, such as chordate biology.

Pairwise comparisons indicated no significant difference among the visual, audio, and kinesthetic strategies, suggesting that all three innovative approaches were similarly effective in enhancing performance. This finding aligns with Usman (2018), who reported that while learning styles vary, multi-sensory engagement generally improves learning outcomes across different modalities. Similarly, Miller and Hanson (2019) found no significant difference between visual and auditory instructional methods when used in combination with hands-on activities, highlighting that diverse approaches can yield comparable benefits. These results suggest that teachers can select any of the VAK strategies according to available resources, learner preference, and classroom context, without compromising effectiveness.

The results showed that male and female students performed comparably when taught using the VAK strategies, with no statistically significant differences. The finding is however in disagreement with that of Dharmayanti 2023, Yuyun, 2021, Suyitno, 2021, Subuh, 2021, Nur, 2020, Ramadian, Oki, Bambang and Suryati (2019), who reported a significant difference in the performance of male and female of the experimental group-favoring male of the experimental. Also in line with the finding of this study there is no gender difference in the academic performance of NCE Biology students exposed to VAK teaching strategy. Since the method allows students to carry out investigation on their own and to arrive at a particular concept, it makes what they learn meaningful and promotes their understanding of the concept despite gender difference among the students. This finding supports the work of Okeke and Chukwu (2019), who reported that multi-sensory teaching reduces gender disparities in science learning outcomes. The result implies that VAK strategies are equally beneficial for both male and female students, reinforcing the idea that learning style-based instruction can promote inclusive education. It further suggests that gender does not need to be a primary consideration when implementing VAK strategies for Biology instruction.

Conclusion

The study concluded that, the VAK teaching strategy was effective in improving performance in chordates concepts than the conventional method. While there were no significant differences in performance between male and female students across the different VAK teaching strategies.

Recommendations

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

1. Chordates concepts in Biology should be taught in a way that actively engages and involves students. The VAK teaching strategy have proven impact in fostering student participation. Therefore, teachers should utilize these strategies when teaching chordates concepts in Biology at NCE level.
2. Teachers should be encouraged to use VAK teaching strategies in teaching chordates concepts instead of the lecture method to improve academic performance at NCE level.
3. Professional associations like the Science Teachers Association of Nigeria (STAN), the Mathematics Association of Nigeria (MAN), and the Nigeria Educational Research and Development Council (NERDC) should organize workshops to train and retrain NCE teachers on the use of constructivist teaching strategies such as VAK teaching strategies.

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