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Effects of STAD Strategy on Achievement in Nervous System Concept among Secondary School Male and Female Field-Dependent and Field-Independent Learners in Bwari Area Council, Abuja, Nigeria

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Abstract

Gender has long been investigated as a potential predictor of academic achievement in science disciplines. Scholars have attributed observed gender disparities in achievement to factors such as task difficulty, cognitive competence, and persistent gender stereotypes. This study investigated gender as predictor of achievement among Field-dependent and Field – Independent secondary Biology students taught the nervous system using Student –Teams - Achievement –Division (STAD) in Abuja, Nigeria. The study adopted a quasi-experimental pre-test- post-test research design. A sample of 133 Senior Secondary School 11 (SS2) students was drawn using multi stage sampling technique from a population of 7,756 SS2 students in Bwari Area Council. For data collection, two instruments- Nervous System Achievement Test (NSAT) and Group Embedded Figure Test (GEFT) were used. The reliability of the instruments was determined using Kuder-Richardson formula 21 (K-R21) and both yielded reliability coefficients of 0.88 for NSAT and 0.81 for GEFT. The research questions were answered with means and standard deviation while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. Findings revealed that males had higher achievement scores than the females and field-independent learners performed better than the field-dependent learners. The results also revealed the effectiveness of STAD as an excellent approach for conveying complex and abstract concepts such as the nervous system. Consequently, it was recommended that biology teachers adapt instructional strategies such as STAD and consider students learning styles in order to encourage collaborative learning in heterogeneous groups, promote individual accountability and provide equal opportunities for achievement.

Keywords: Student Teams Achievement Division, Field-Dependent Students, Field- Independent Students and Achievement.

Introduction

Gender encompasses the economic, social, political, and cultural attributes and opportunities linked to being male or female, varying across cultures and over time. The World Health Organization defines it as socially constructed roles, behaviours, activities and attributes that societies consider appropriate for women, men, girls and boys, distinguishing it from biological sex. In Science Education, particularly Biology, gender has long been investigated as a potential predictor of academic achievement in science disciplines, with mixed findings across contexts influenced by instructional methods and contextual factors. Studies like Etobro and Fabinu (2017) report that gender has no significant influence on achievement scores of students in Biology when equitable instructional practices are applied (e.g., experiential and cooperative methods), highlighting that males and females can perform comparably when classroom environments support engagement for all learners. Conversely, Sada and Adamu (2023), identifies differential outcomes across gender suggesting that gender may interplay with psychological and contextual factors to shape academic results in STEM domains. Academic achievement in Biology remains an integral goal of effective science education, fostering conceptual mastery which is critical to students' future pathways in STEM careers. Despite the importance of Biology, it is worrisome to note that many secondary school learners continue to fluctuate or perform below expectations in science subjects, including Biology (Saka and Onanuga, 2022). The likely causes of fluctuating performance have continuously grabbed the attention of stakeholders in science education and how to combat this continuous trend. Research suggests that multiple factors such as topic difficulty, learner characteristics such as gender and cognitive style interact with instructional strategies to influence achievement. As regards difficulty of a topic, Ezechi (2019), identified nervous system as a particularly challenging Biology topic for students. The West African Examination (WAEC) chief examiners' report (from 2008-2023) on students' achievement in nervous system gives credence to Ezechi's assertion. According to the report, students find it



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extremely difficult to spell technical terms, they illustrate reflex arcs with poor diagrams which are often untitled, improperly titled and unlabelled. In many cases, guidelines were drawn with free hand and did not touch the structure to be labelled and most students omit vital parts when required to draw a nerve cell/neuron. Consequently, this affects their performance in a topic such as nervous system which covers about 10- 15% of the questions in biology examination. Moreover, individual cognitive styles particularly field-dependent (FD) and field-independent (FI) orientations have been shown to affect how learners process, organize, and recall scientific information. Field-independent learners typically outperform field-dependent peers in science. Previous studies in secondary education contexts have found that field-independent students tend to achieve higher academic scores in science disciplines compared to their field-dependent peers, and that cognitive style may mediate instructional effects on achievement (Saka and Onanuga, 2022). Student Teams-Achievement Divisions (STAD), a cooperative learning strategy grounded in social interdependence theory, has demonstrated efficacy in enhancing academic achievement across subjects by fostering peer support and active engagement. Cooperative learning paradigms like STAD have been associated with improved academic achievement and sustained knowledge retention, particularly when learners collaboratively construct understanding of complex topics like the nervous system. Despite evidence on STAD and cognitive style, limited studies have jointly examined gender and cognitive style as predictors of achievement in the nervous system using STAD in Nigerian secondary schools. By examining how gender and cognitive style jointly influence immediate learning, the study offers a deeper understanding of instructional equity and cognitive diversity in science education, potentially improving achievement in challenging Nigerian contexts like WAEC exams.

Objectives of the Study

The main objective of this study is to investigate gender as predictor of achievement among Field-dependent and Field-Independent secondary Biology students taught the nervous system using Student –Teams - Achievement –Division (STAD) in Abuja, Nigeria.

The study seeks :

1. To determine the influence of gender on field-dependent students' achievement when taught the nervous system using STAD.
2. To determine the influence of gender on field-independent students' achievement when taught the nervous system using STAD.

Research Questions

1. What are the mean achievement scores of male and female field-dependent Senior Secondary School 2 biology students taught the nervous system using STAD?
2. What are the mean achievement scores of male and female field-independent Senior Secondary School 2 biology students taught the nervous system using STAD?

Hypotheses

H₀₁: There is no significant difference in the mean achievement scores of male and female field-dependent Senior Secondary School 2 biology students taught nervous system using STAD.

H₀₂: There is no significant difference in the mean achievement scores of male and female field-independent Senior Secondary School 2 biology students taught nervous system using STAD.

Methodology

This study employed a quasi-experimental design comprising two experimental groups (the field-dependent group and field-independent group), which participated in the pre-test and post-test focused on achievement in the nervous system. The population of the study was 7,756 senior secondary II students in all eleven (11) coeducational schools in Bwari Area Council. After formal permission was given by the school authorities, a sample of 133 students were selected from the population using multistage sampling technique. The sample comprised 74 males and 59 females respectively. Data were collected using two instruments; Nervous System Achievement Test (NSAT) which yielded a reliability index of 0.88 and Group Embedded Figure Test (GEFT) adapted from Herman Witkin which yielded a reliability index of 0.81. NSAT comprised 40 multiple choice test items adopted from past questions in JAMB and SSCE to determine achievement in nervous system. While GEFT comprised 18 complex figures administered within 20 minutes to test and determine cognitive style of the respondents. The higher the score of the respondents, the more field-independent the respondent is.



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A respondent who scores 9 or more marks is classified as field-independent while a respondent who scores lesser than 9 is classified as field-dependent. Data analysis was conducted using mean and standard deviation and Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

Presentation of Results

Research Question One

What are the mean achievement scores of male and female field-dependent senior secondary students taught nervous system using STAD?

The result to answer this research question is presented in Table 1.

Table 1: Mean Achievement Scores and Standard Deviations of Male and Female Field- Dependent Students Taught Nervous System Using STAD

Gender FD		Pre-test	Post-test
Male	Mean	13.42	22.76
	N	38	38
	Std. Deviation	2.445	2.476
Female	Mean	13.33	21.27
	N	30	30
	Std. Deviation	3.437	2.318

Table 1 shows the mean achievement scores of male and female field-dependent students taught nervous system using STAD. The results from the table indicate sample sizes of 38 and 30 respectively, the male had a pre-test score of 13.42 with a standard deviation of 2.445 and a post-test score of 22.76 and a standard deviation score of 2.476 while the female had a pre-test score of 13.33 with a standard deviation of 3.437 and a post-test score of 21.27 with a standard deviation of 2.318.

Research Question Two

What are the mean achievement scores of male and female field-independent Senior Secondary biology students taught nervous system using STAD?

The result to answer this research question is presented in Table 2.

Table 2 Mean Achievement Scores and Standard Deviations of Male and Female Field -Independent Students Taught Nervous System Using STAD

Gender FI		Pre-test	Post-test
Male	Mean	18.64	29.81
	N	36	36
	Std. Deviation	2.900	3.495
Female	Mean	19.86	25.69
	N	29	29
	Std. Deviation	2.216	2.285

Table 2 shows the mean achievement scores of male and female field-independent students taught nervous system using STAD, the male student had a pre-test score of 18.64 with a standard deviation of 2.900 and a post-test score of 29.81 and a standard deviation score of 3.495, while the female had a pre-test score of 19.86 with a standard deviation of 2.216 and a post-test score of 25.69 with a standard deviation of 2.285 respectively.

Hypothesis One

H₀₁: There is no significant difference in the mean achievement scores of male and female field-dependent senior secondary students taught nervous system using STAD.

The result to test this hypothesis is presented in Table 3.

Table 3: ANCOVA Result of Mean Achievement Scores of Male and Female Field- Dependent Senior Secondary Students Taught Nervous System Using STAD

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	52.268 ^a	2	26.134	4.616	.013	.124
Intercept	1186.366	1	1186.366	209.542	.000	.763
Pre-test	14.724	1	14.724	2.601	.112	.038
Gender FD	36.828	1	36.828	6.505	.013	.091



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Error	368.011	65	5.662
Total	33641.000	68	
Corrected Total	420.279	67	

a. R Squared = .124 (Adjusted R Squared = .097)

Table 3 shows the results of analysis of co-variance of the mean achievement scores of male and female field-dependent students taught nervous system using STAD. It is observed from the table that the F ratio of 6.505 was obtained with associated probability value of 0.013 i.e. ($F = 6.505, P = .013 < \alpha = .05$). Since the associated probability 0.013 is less than 0.05 set as level of significance, the hypothesis was rejected. It therefore implies there was a significant difference between the mean achievement scores of male and female field-dependent students taught nervous system using STAD.

Hypothesis Two

H₀₂: There is no significant difference in the mean achievement scores of male and female field-independent senior secondary students taught nervous system using STAD.

The result to test this hypothesis is presented in Table 4.

Table 4: ANCOVA Result of Mean Achievement Scores of Male and Female Field- Independent Senior Secondary Students Taught Nervous System Using STAD

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	297.740 ^a	2	148.870	16.837	.000	.352
Intercept	608.282	1	608.282	68.795	.000	.526
Pre-test	25.648	1	25.648	2.901	.094	.045
Gender FI	296.438	1	296.438	33.526	.000	.351
Error	548.198	62	8.842			
Total	51694.000	65				
Corrected Total	845.938	64				

a. R Squared = .352 (Adjusted R Squared = .331)

Table 4 shows the results of analysis of co-variance of the mean achievement scores of male and female field-independent students taught nervous system using STAD. It is observed from the table that an F ratio of 33.526 was obtained with associated probability value of .000 i.e. ($F = 33.526; P = .000 < \alpha = .05$). Since the associated probability .000 is less than 0.05, the hypothesis was rejected. It therefore implies there was a significant difference between the mean achievement scores of male and female field-independent students taught nervous system using STAD. In other words, field-independent male students performed better than the field-independent female students taught nervous system using STAD.

Discussion of Findings

The findings of this study reveal gender as predictor of achievement among field-dependent and field-independent secondary biology students taught nervous system using STAD in Abuja, Nigeria. The discussion is in line with the key variables in the study gender, STAD, cognitive styles (field-dependent and field-independent) and achievement.

Gender: Gender differences were evident in the achievement scores of both male and females. Male students achieved significantly higher mean scores compared to female students when taught using STAD. This aligns with the study of Sada and Adamu (2023) but contradicts that of Etobro and Fabinu (2017) who argued that gender does not influence biology achievement. The competitive nature of STAD appear to resonate more with male learners while female learners may benefit less due to difference in group dynamics and learner traits.

STAD (Student Teams Achievement Division): The findings of the study indicate that students achievement scores increased significantly after they were taught using the STAD method. This aligns with previous studies of Chopel et al., (2023); Gana, (2023); Sada and Adamu, (2023), which demonstrated that cooperative learning strategies like STAD promote better academic outcomes. The effectiveness of STAD can be attributed to its foundation in Positive Interdependence Theory, emphasizing individual accountability, group performance, and peer teaching.

Cognitive Style (Field-Dependent vs. Field-Independent): The study revealed significant differences in achievement between field-dependent and field-independent students taught using STAD. Field-independent students performed better than their field-dependent counterparts, supporting findings from Ahmed and Aliyu (2020) and Agu and Samuel (2019). This suggests that cognitive styles influence how students



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process visual, social, and environmental aspects of learning. However, the findings refute that of Saka and Onanuga (2022), who reported no significant differences between these cognitive styles. The disparity may arise from the interactive nature of STAD, which aligns more closely with field-independent learners' strengths in self-directed learning.

Achievement: Achievement scores were significantly influenced by both gender and cognitive style. Male students outperformed their female counterparts when taught using STAD. This finding contradicts the studies of Jacob et al. (2022) and Ihejiamaizu et al. (2020), which found no gender differences in achievement scores. Likewise, cognitive style influenced achievement score of learners; field-independent learners achieved higher than their field-dependent counterparts. This finding agree with Agu and Samuel (2019); Ahmed and Aliyu (2020); Nnabuife (2021); Sada and Adamu (2023) and Gana (2023).

Conclusion

The findings of this study concluded that gender is a significant factor that affected students' achievement in nervous system. There was a significant difference in the mean achievement scores of male and female field-independent and field-dependent students taught nervous system using STAD. The males outperformed their female counterparts. Likewise, the findings of this study have shown the effectiveness of STAD as a superior teaching approach for conveying complex and abstract concepts such as nervous system in Biology. The evidence suggests that STAD not only enhances understanding but also promotes student engagement in challenging topics. It equally encourages students to collaborate in order to improve their achievement at individual level and as a team.

Recommendations

1. Biology teachers should be encouraged to adapt Student Teams Achievement Division to enhance overall achievement in nervous system and other difficult topics in biology like homeostasis, evolution, skeletal system and genetics to mention just few.
2. Biology teachers should consider students learning style to enable them tailor their instructions to meet the needs of their students.
3. Biology students should be encouraged to work collaboratively in heterogeneous groups (Male, Female, field-dependent and field-independent) to promote individual accountability and provide an opportunity for equal achievement.

References

- Agu, P. A. & Samuel, I. R. (2018). Effect of cooperative learning (STAD, jigsaw II and TAI) strategies on basic science and technology students' achievement and retention. *International Journal of Modern Education Research*, 5(2), 26-31.
- Ahmed, A. & Aliyu, A. (2020). Influence of field-dependence and independence learning styles on academic performance of secondary school students in Katsina zonal education. *Al-Hikmah Journal of Education*, 7(1), 17-23
- Chopel. S., Tshewang, P., Wangdi, P., Wangdi, U., & Jamtsho, S. (2023). Implementing Student Teams Achievement Divisions (STAD) learning model in grade 9 Biology and its impact on learning achievement. *International Research Journal of Science, Technology, Education, and Management*, 3(2), 65-77. <https://doi.org/10.5281/zenodo.8139804>
- Etobro, B. & Fabinu, E. (2017). Students' perception of difficult concepts in biology in Senior secondary schools in Lagos State. *Global Journal of educational research*. Vol 16. pp139-147.
- Ezechi, G.C. (2019). Attitude towards Biology and Its Effects on Students' Achievement. *International Journal of Engineering and Scientific Research*. 7 (3), 53-63.
- Gana, B. K., Gana, M. N., Buda, M. K., Mamman, R. & Thomas, T. (2023). Effects of system concept mapping on academic performance and retention in nervous system among secondary school students in Niger State, Nigeria. *Rivers State University Journal of Education*. 26(1), 130-137.
- Ihejiamaizu, C. C., Neji, H. A. & Agiande, I. U. (2020). Effect of cooperative learning strategy on senior secondary school students' academic performance in biology in Cross River state, Nigeria. *European Journal of Scientific Research*, 156 (2) ,138 – 144.
- Jacob, N. I., Akarinwa, C. & Okolo, N. M. (2022). Effects of STAD cooperative learning strategy on the academic achievement of senior secondary school students in biology in Bauchi metropolis. *Galaxy International Interdisciplinary Research Journal*, 10(6), 642–658.



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Nnabuiife, C (2021). Influence of cognitive styles and attitudes on students' academic achievement in biology in ihitte/uboma local government Area, Imo State. <https://repository.mouau.edu.ng/work/view/influence-of-cognitive-styles-and-attitudes-on-students-academic-achievement-in-biology-in-ihitteuboma-local-government-area-imo-state-7-2>

Saka, A. O., & Onanuga, P. A. (2022). Achievement motivation and students' achievement in secondary biology: Is the relationship mediated by cognitive style? *Sakarya University Journal of Education*.12(1), 58-76. doi: <https://doi.org/10.19126/suje.980052>