

# **Influence of Classroom Interaction Patterns and Students' Cognitive Styles on Achievement in Biology in Senior Secondary Schools in Zaria Local Government Area, Kaduna State**

**Omoniwa, O. O., Salisu, Z.I. & Yawa, E. P.**

alakeoluwatope@gmail.com, zeosalis@gmail.com,  
08038087252, 08037065895

Department of Biology  
Federal University of Education, Zaria

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## **Abstract**

*The study was on Influence of Classroom Interaction Patterns and Students' Cognitive Styles on Achievement in Biology in Senior Secondary Schools in Zaria Local Government Area, Kaduna State. Three research objectives, three research questions, and three null hypotheses guided the study. The review of literature in the study was carried out. Descriptive survey design was adopted for the study. The sample for the study comprised of two hundred and ninety-one (291) biology students drawn from the population of study using simple random sampling techniques. The instruments for data collection in this study were a questionnaire and analyzed using mean, standard deviation, and t-test. The results revealed that there is a significant relationship between classroom interaction, cognitive styles, and students' achievement in Biology. There is a significant relationship between students' attitude and their academic achievement in Biology and there is no gender difference in the academic achievement of Biology students. The researcher concluded by recommending that educators should adopt diverse instructional strategies that cater to different cognitive styles, this may include incorporating visual aids, hands-on activities, and group discussions to accommodate varied learning preferences, among others.*

**Keywords:** Interaction Patterns, Students' Cognitive Styles, Classroom, Achievement Biology

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## **Introduction**

Science and technology have significantly enhanced humanity's ability to control and understand the world and its environment. In many developing nations, there is a growing emphasis on improving the teaching of science and related subjects, including biology, in schools. Biology holds a unique position in the secondary school curriculum as the science of life. In Nigeria, the secondary school biology curriculum aims to encourage students to explore natural phenomena,

deepen their understanding of biological sciences, and apply scientific knowledge to daily life, including personal, community, health, and agricultural matters (FME, 2009). Biology is a crucial subject for various fields of learning and contributes significantly to a nation's technological advancement. It is introduced at the senior secondary school level as a preparatory stage for nurturing students' career abilities, discovering and energizing their potentials and talents (Federal Republic of Nigeria, 2014). Biology

enjoys higher enrolment among students in Senior Secondary Certificate Examinations (SSCE) compared to physics and chemistry, reflecting its importance in education. A solid grasp of biology is a prerequisite for entering professions such as medicine, pharmacy, nursing, agriculture, forestry, biotechnology, nanotechnology, and more (Malik et al., 2023). This underscores the pivotal role of biology in the development of any growing economy.

Achievement, as defined by Aniaku (2012), refers to the quantity and quality of knowledge and skills acquired by individuals or groups in a specific area of study, and how this knowledge can be applied to address societal problems. It signifies the attainment of academic goals and the educational outcomes of students, demonstrating the extent to which students, teachers, or instructors have reached the stated objectives (Aniaku, 2012). It's well-established that students' achievement is influenced by their teachers' teaching methods. Okoyefi and Nzewi (2015) observed that teachers' teaching methods positively impact students' cognitive achievement in science subjects. Opara (2011) also noted that teachers' teaching approaches affect students' cognitive achievement in science. However, students' academic abilities vary, leading to differing responses to specific teaching methods. Teachers employ various teaching methods to facilitate meaningful learning, including conventional methods, lecture-based teaching, demonstrations, and projects. The conventional teaching method, as described by Awotua-Efeby (2012), is typically teacher-centred, with passive student roles and content presented as absolute knowledge. Unfortunately, many science

teachers in Nigerian secondary schools predominantly use the conventional method due to limited exposure to learner-centred methods, leading to lower cognitive achievement. Therefore, there is a pressing need to improve instructional strategies, such as classroom interaction patterns.

Gender plays a role in students' academic achievement in biology. Societal expectations and roles assigned to different genders have led to the misconception that science is primarily a male domain. Some educators tend to associate science subjects like physics and chemistry with masculinity, encouraging females to pursue biology, agricultural science, and home economics, which are considered more female-friendly science subjects. However, researchers like Okoyefi and Nzewi (2015) argue that gender does not significantly influence students' achievement, and students perform equally when provided equal opportunities. Therefore, this study aims to investigate the impact of gender on the cognitive achievement of biology students when exposed to an interactive application of interaction patterns. This approach integrates all plausible classroom interaction patterns, referred to as "whole-class interactive teaching" (Ogbu, 2021). Whole-class interactive teaching involves skilfully applying various interaction patterns in each lesson, making classroom interactions predominantly student-centred and teachers acting as facilitators.

Classroom interaction patterns, as defined by Ogbu (2021), are categorized into four major types: Teacher-student interaction pattern: Interaction between the teacher and individual students or groups of students,

Students-students interaction pattern: Interaction among students, which can be cooperative, competitive, or individualistic, Teacher-material interaction pattern: When the teacher uses instructional materials, machines, or equipment to enhance learning and Students-material interaction pattern: When students engage with instructional materials, machines, or equipment to solve practical problems or conduct experiments. Classroom interaction patterns serve as an instructional strategy where teachers ensure effective application of these patterns in each lesson. This approach optimizes the advantages of each interaction pattern while skilfully mitigating their disadvantages.

### Statement of the Problem

Despite the critical role biology plays as a foundational subject in a nation's pursuit of scientific and technological advancements, there is substantial evidence of low academic achievement among Nigerian students in this subject (as indicated in the Chief Examiners' Reports from 2015 to 2020). This worrisome trend raises concerns about the potential shortage of skilled professionals in the fields of science and technology in Nigeria. Such a shortfall could impede Nigeria's progress toward achieving its vision of becoming one of the world's top 20 industrialized nations by 2010. The results for the year 2017 reveal that merely 9.51 percent of students achieved distinction and credit grades, while a staggering 90.49 percent received pass and fail grades. Notably, none of the results between 2015 and 2020 demonstrated an attainment rate exceeding 40 percent in the distinction/credit category. This concerning trend has been attributed to suboptimal instructional strategies, resulting in less-than-adequate cognitive achievement among

students. Therefore, this research endeavour aims to investigate the impact of classroom interaction patterns and students' cognitive styles on biology achievement among secondary schools in Zaria, Kaduna State.

### Objectives of the Study

The objectives of this study are to:

- i. Examine classroom interaction patterns and cognitive styles influencing students' achievement in Biology.
- ii. Identify the students' attitude influencing their achievement in Biology
- i. Determine gender disparity in the achievement of Biology students.

### Research Questions

The following research questions guided the study:

- i. What are the classroom interaction patterns and cognitive styles that have an impact on students' achievement in Biology?
- ii. What factors contribute to students' attitudes that influence their achievement in Biology?
- iii. Is there a significant gender disparity in the achievement of Biology students?

### Research Hypotheses

The following null hypotheses were formulated to guide this study:

H01. There is no significant relationship between classroom interaction patterns and cognitive styles and students' achievement in Biology.

H02. There is no significant relationship between students' attitudes and their achievement in Biology.

H03. There is no significant gender disparity in the achievement of Biology students.

### Methodology

The study adopted a descriptive survey research design to explore the target population of students in public senior secondary schools within Zaria Local Government Area, Kaduna State. The study focused on a total of five public Senior Secondary Schools in Zaria, with a combined population of 1,228 SS II Biology students. From this population, 291 students were selected as the sample size, determined according to Krejcie and Morgan's (1970) table. Data was gathered through a structured questionnaire, designed using a

four-point rating scale: Strongly Agree (SA) – 4, Agree (A) – 3, Disagree (D) – 2, and Strongly Disagree (SD) – 1. The researchers personally administered the questionnaires to the respondents in their respective schools, ensuring face-to-face interaction. To analyze the data and test hypotheses, inferential statistics such as the Pearson Product Moment Correlation (PPMC) and t-test were employed, with a significance level of 0.05.

### Results

**Null Hypotheses One:** There is no significant relationship between classroom interaction patterns and cognitive styles and students' achievement in Biology.

**Table 1: Relationship between classroom interaction patterns and cognitive styles and students' achievement in Biology**

Variables	Mean	SD	N	r-cal.	r-crit.	Df.	Sig
Classroom Interactions	13.84	6.654	236	0.302	1.95	234	0.000
Achievement Test	60.19	15.535					

The results of the test conducted for null hypothesis one (1), as presented in Table 1, indicate that the calculated correlation coefficient (r-calculated) of 0.302 is less than the critical correlation coefficient (r-critical) of 1.95 at a 0.05 significance level. Consequently, the null hypothesis is rejected, signifying a significant

relationship between classroom interaction, cognitive styles, and students' achievement in Biology.

**Null Hypothesis Two:** There is no significant relationship between students' attitudes and their achievement in Biology

**Table 2: Relationship between students' attitude and their achievement in Biology**

Variables	Mean	SD	N	r-cal.	r-crit.	Df.	Sig
Students' Attitude	15.43	6.214	236	0.325	1.95	234	0.000
Achievement Test	60.19	14.535					

The outcome of the analysis as shown in Table 2 revealed that the r-calculated of 0.325 is less than the r-critical of 1.95 at 0.05 level of significance. This implies that there is a significant relationship between

students' attitude and their academic achievement in Biology.

**Null Hypothesis Three: There is no significant gender disparity in the achievement of Biology students**

**Table 3: Gender disparity in the achievements of Biology students**

Variables	t-crit	Sig	t-cal	Df.	Mean Difference	Standard Difference
Male	1.872	3.992	2.132	234	0.977	0.324
Female	1.867	3.992	2.139			

The result of the analysis shown in Table 3 revealed t-calculated of 1.872 for the male students and 1.867 for the females which are greater than t-critical of 0.977 at 0.05 level of significance. Hence, the null hypothesis is accepted, meaning there is no gender difference in the academic achievement of Biology students.

### Discussion of Findings

The identified significant relationship between classroom interaction, cognitive styles, and students' achievement aligns with contemporary educational psychology theories. Vygotsky's Social Development Theory emphasizes the importance of social interactions in learning (Vygotsky, 1978). Classroom interaction provides students with opportunities for collaborative learning, allowing them to construct knowledge collectively (Johnson & Johnson, 2019). Cognitive styles, such as visual, auditory, or kinesthetic preferences, influence how students process information (Riding & Rayner, 1998). Understanding and integrating diverse

cognitive styles in classroom interaction can enhance students' comprehension and retention, positively impacting academic achievement (Felder & Silverman, 1988). The identified significant relationship between students' attitude and academic achievement is consistent with the literature on motivational and affective factors in learning. The Expectancy-Value Theory posits that students' beliefs about their capabilities and the perceived value of a subject influence their motivation and academic performance (Eccles & Wigfield, 2002). Positive attitudes towards learning foster engagement, persistence, and a conducive learning environment, leading to improved academic outcomes (Pekrun, 2006). Educators should consider strategies to cultivate positive attitudes in students to enhance their academic achievements in Biology.

The absence of a gender difference in academic achievement aligns with research challenging traditional gender stereotypes in education. The Gender Similarities Hypothesis suggests that males and females



are more alike than different in cognitive abilities and academic achievements (Hyde, 2005). Gender-related differences may result from sociocultural factors rather than inherent cognitive disparities (Spelke, 2005). In Biology, where cognitive abilities play a crucial role, the findings support the idea that both male and female students can excel without significant gender-based variations (Halpern et al., 2017).

These findings underscore the multifaceted nature of factors influencing students' achievement in Biology, encompassing social interactions, cognitive styles, attitudes, and challenging gender stereotypes. Educators should consider these insights when designing instructional strategies to create inclusive and effective learning environments. Further research could explore specific elements within classroom interaction and cognitive styles that contribute most significantly to academic achievement in Biology.

### Conclusion

The findings of this study provide valuable insights into the dynamics influencing students' achievement in Biology, emphasizing the interconnected roles of classroom interaction, cognitive styles, and students' attitudes. The identification of a significant relationship between these factors underscores the importance of holistic and student-centric approaches to biology education. The recognition of the impact of classroom interaction and cognitive styles on academic achievement aligns with contemporary educational psychology theories. Educators should leverage collaborative learning opportunities and consider diverse

cognitive preferences when designing instructional strategies. This approach ensures that students engage meaningfully with the material, fostering a deeper understanding of biology concepts.

Moreover, the acknowledged relationship between students' attitudes and academic achievement highlights the crucial role of motivational and affective factors in the learning process. Creating a positive learning environment, cultivating intrinsic motivation, and emphasizing the value of biology education can contribute to improved student outcomes. The absence of a gender difference in academic achievement challenges stereotypical notions and underscores the need for inclusive educational practices. Biology educators should continue promoting a gender-neutral learning environment that encourages all students, regardless of gender, to excel in the subject.

### Recommendations

The researcher recommended as follows:

1. Educators should adopt diverse instructional strategies that cater to different cognitive styles. This may include incorporating visual aids, hands-on activities, and group discussions to accommodate varied learning preferences.
2. Creating a positive and inclusive learning environment is essential. Educators should pay attention to students' attitudes, providing support and encouragement to enhance their motivation and interest in Biology.
3. Given the positive impact of classroom interaction, educators should design

activities that promote collaborative learning. Peer-to-peer discussions, group projects, and interactive sessions can enhance students' comprehension and retention.

## References

- Aniaku, O.L. (2012). Effect of guided and unguided inquiry teaching methods on secondary school students' achievement and interest in biology in Enugu State. Unpublished M.Sc Thesis University of Nigeria Nsukka.
- Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineering education*, 78(7), 674-681.
- Federal Ministry of Education. (2009). Nigeria Country Report. 17th Conference of Commonwealth Ministers of Education, Kuala Lumpur, Malaysia. Retrieved from: [http://www.create-rpc.org/pdf\\_documents/ccemaccount.pdf](http://www.create-rpc.org/pdf_documents/ccemaccount.pdf).
- Halpern, D. F., Benbow, C. P., Geary, D. C., Gur, R. C., Hyde, J. S., & Gernsbacher, M. A. (2017). The science of sex differences in science and mathematics. *Psychological Science in the Public Interest*, 8(1), 1-51.
- Hyde, J. S. (2005). The gender similarities hypothesis. *American psychologist*, 60(6), 581-592.
- Johnson, D. W., & Johnson, R. T. (2019). An educational psychology success story: Social interdependence theory and cooperative learning. *Educational researcher*, 38(5), 365-379.
- Malik, S., Muhammad, K., & Waheed, Y. (2023). Nanotechnology: A Revolution in Modern Industry. *Molecules* (Basel, Switzerland), 28(2), 661. <https://doi.org/10.3390/molecules28020661>
- Ogbu, S. O. (2021). The place of classroom interaction pattern in science education. *Educational Research Quarterly*, 35(1), 29-42.
- Okoyefi, Q.O. & Nzewi, U.M. (2015). Effect of material and nonmaterial reinforcement on pupils' achievement in basic sciences. *STAN Journal* 50(1), 40–47.
- Opara, J.A. (2011). Inquiring method and students' academic achievement in biology: lessons and policy implications; *American Eurasian Journal of Scientific Research*, 6(1), 28–31
- Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational psychology review*, 18(4), 315-341.
- Riding, R. J., & Rayner, S. (1998). Cognitive styles and learning strategies: Understanding style differences in learning and behavior. David Fulton Publishers.
- Spelke, E. S. (2005). Sex differences in intrinsic aptitude for mathematics and science?: A critical review. *American Psychologist*, 60(9), 950–958.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.