AFRICAN JOURNAL OF

EDUCATIONAL MANAGEMENT

ISSN 0795 – 0063 Volume 26, Nos. 1&2, 2025

A JOURNAL OF THE DEPARTMENT OF EDUCATIONAL MANAGEMENT, UNIVERSITY OF IBADAN

HIS LINEAGE PUBLISHING HOUSE
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Table of Contents

INFLUENCE OF CLASS SIZE AND TEACHER CLASSROOM BEHAVIOURS ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENTS IN BIOLOGY IN IBADAN METROPOLIS, OYO STATE, NIGERIA

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Abstract
Despite the importance accorded to biology, several factors were attributed to poor students' academic achievement. Guided by six research questions, this study investigates the influence of class size and teacher classroom behaviours on senior secondary school academic achievement in biology in Ibadan Metropolis, Oyo State. A descriptive survey design was adopted for this study. Teachers' Questionnaire on classroom behaviours (α = 0.92), Students' Questionnaire on teacher classroom behaviours (α = 0.82), and Biology Students Achievement Test (r=0.79) were the instruments used to collect data for the study. The results revealed a negative, moderate significant relationship between classroom size (r = -0.52; p<0.05) and students' achievement and weak, non-significant relationships between teacher classroom behaviours and students' achievement: instructional methods (r = -0.02), teacher questioning (r = 0.03), classroom interaction (r = -0.07), and teaching effectiveness (r = -0.02). Based on these findings, for students' achievement in biology to improve, class size needed to be reduced.

Keywords: Biology, academic achievement, Teacher classroom Behaviours, class size

Introduction

Biology as a subject records the highest number of students among most upper secondary students in Nigeria when compared to other science subjects, as it is the favoured and preferred science subject offered by science students (Nwoke et al., 2022; Ose-Aigbekaen & Osasogie, 2020). Among the sciences, Biology is known for its educational relevance, its direct connection to human life, its experimental nature, and its strong interdisciplinary links with other scientific fields (Arokoyu & Chukwu, 2017). While the acquisition and understanding of student's knowledge in Biology at senior and tertiary levels are measured by their achievement in the subject, several studies have observed that students' achievement in Biology in spite of its importance and popularity, has not been very impressive both at internal and external examinations such as the West African Examinations Council (WAEC) and National Examination Council (NECO) for the secondary school level (Ahmed, 2008; Agboghoroma & Oyovwi, 2015).

According to the WAEC Chief Examiner's Report over the past decade (2014 - 2024), biology candidates have several problems, such as poor understanding of key concepts in ecology, genetics, and conservation, misinterpretation of questions, weak practical skills, especially in biological drawings, and poor spelling of scientific terms. However, several researchers have identified some contributing factors beyond content knowledge, such as student-related factors, teacher-related factors, societal expectations, infrastructural problems, and academic language (Ali & Chacko, 2013; Felder, 2013; Ali et al., 2014; Bichi et al., 2019). Instructional strategies, students' learning differences, laboratory facilities for hands-on activities, and teacher characteristics such as qualifications, experience, and pedagogical content knowledge have also been identified to influence student performance in Biology (Alebiosu, 2012; Arokoyu & Chukwu, 2017).

Ashimole (2011) emphasized that the success of teaching and learning largely depends on the number, quality, and commitment of teachers, which form the foundation of an effective educational system. Similarly, the Federal Republic of Nigeria in the National Policy on Education (FRN, 2004) also recognized the importance of teachers by stating that no nation's education system can be greater than the standard of its teachers. Despite the importance of teachers, student

performance in both internal and external examinations remains low, with researchers often attributing this to various teacher-related classroom characteristics (Ibe, 2013; Bosco et al, 2023).

Further compounding these issues is the challenge of large class sizes on student performance. Class size is an important factor with respect to the achievement of students in educational settings. The National Policy on Education stipulates that the teacher-student ratio in secondary schools should be 1:40 (FRN, 2004; FRN, 2014). There has been a consensus among researchers that student achievement decreases as class size increases (Kedney, 2013; Ehebha & Adeyinka, 2022; Ruffina et al., 2018). Yet very little is known about the effects of class size on student achievement in Biology at the secondary school level (Ruffina et al., 2018).

Past studies have identified approximately ten teacher behaviours that are strongly linked to improved student academic achievement, particularly when measured by classroom assessments and standardized tests (Borich, 2004). These key behaviours included instructional methods, teachers' questioning, classroom interaction, teachers' effectiveness, communication skills, use of resources, teachers' abilities to use students' ideas and probe students' comments, and teachers' ability to manage resources and implement evaluation, among others. Studies highlighted that a teacher's behaviour, when interacting with students, can have a lasting positive or negative impact on how the students perceive the learning environment (Telli et al., 2010; Kang'ahi et al., 2012; McLure et al., 2022). Also, studies have revealed that asking higher-order questions is fundamental to student learning (Kängsepp, 2011; Barnett & Francis, 2012; Peterson & Taylor, 2012). A study by Fakolade et al (2024) found that the relationship between teacher-student classroom interaction and student interest in Biology revealed an increased interest. An expanding body of research on teacher effectiveness has reinforced the understanding that specific teacher characteristics significantly influence student academic achievement (Muijs et al., 2014). While these behaviours have been consistently supported by several studies over the years (Panayiotou et al., 2014; Azigwe et al., 2016; Teodorović et al., 2021), a limited number of these studies have focused on the joint contribution of these behaviours to students' academic achievement (Chika, 2012; Olagunju & Babayemi, 2014; Maulana et al.,

2015). However, this study investigated the relative and joint contribution of class size and teachers' classroom behaviours (use of instructional methods, questioning, classroom interaction, and teaching effectiveness) on secondary school students' achievement in biology in Ibadan Metropolis.

Research questions

1. What is the (i) class size and (ii) teacher-student ratio in Senior Secondary School biology two (SS2) classes?
2. What is the nature of biology teachers' classroom behaviours in senior secondary schools with respect to the use of instructional methods, questioning, classroom interaction, and teaching effectiveness?
3. What is the relationship between independent variables (class size and teacher classroom behaviours in terms of the use of instructional methods, questioning, classroom interaction, and teaching effectiveness) and the dependent variable (secondary school students' academic achievement in biology)?
4. What are the joint effects of class size and the teacher's classroom behaviours (use of instructional methods, questioning, classroom interaction, and teaching effectiveness) on secondary school students' academic achievement in biology?
5. What is the relative contribution of class size and teacher classroom behaviours (use of instructional methods, questioning, classroom interaction, and teaching effectiveness) on secondary school students' academic achievement in biology?
6. Which of the independent variables would predict secondary school students' academic achievement in biology?

Methodology

The descriptive survey research design was adopted for this study. The population of the study comprised all senior secondary school two (SS2) biology students and biology teachers in Ibadan Metropolis in Oyo State. Ten secondary schools were randomly selected from two local government areas in Ibadan Metropolis, Oyo State. Six hundred (600) students and Twenty (20) teachers participated in this study. The choice

of using SS2 was based on the premise that they had acquired a year of learning experience in secondary school biology. Data was collected using Teachers Questionnaire on Classroom Behaviours (TQCB) with a reliability coefficient of 0.92, Students Questionnaire on Teacher Classroom Behaviours (SQTCB) with a reliability coefficient of 0.82 and Biology Students Achievement Test (BSAT) BSAT which consisted of 25 multiple choice items with four options (A-D) of one key and three distractors. Data collected were analyzed using descriptive statistics of mean, standard deviation, frequency count, and simple percentage, while inferential statistics of Pearson Product-Moment Correlation (PPMC) and multiple regression were also used to answer the research questions at a 0.05 level of significance.

Results and Discussion

Research question 1

Table 1: Profile of Class Size and Teacher-Student Ratio

Class size	Frequency	Percentage
Small	5	50.0
Large	5	50.0
Total	10	100.0

Table 1 revealed that 5 (50%) schools indicated small class sizes with the number of students ranging from one (1) to forty (40) per teacher and 5 (50%) schools indicated large class sizes with the number of students ranging from forty-one (41) to three hundred (300) or more per teacher.

Research question 2: What is the nature of biology teachers' classroom behaviours in senior secondary schools with respect to the use of instructional methods, questioning, classroom interaction, and teaching effectiveness?

Table 2a: Teachers' instructional methods

S/N	Item Statement	Mean	SD
1.	My teacher gives assignment on work already done in biology	3.45	0.71
2.	My teacher criticize responses during biology	3.16	0.87

	lesson		
3.	My teacher uses discussion method during biology lessons	3.07	0.99
4.	My teacher makes use of lecture method always during biology lessons	3.34	0.75
5.	I prefer the use of field trips / excursions in biology to discussion	3.20	0.84
6.	My teacher uses play-way method when explaining some concepts in biology	3.16	0.81
7.	My teacher uses laboratory/ experimental method during biology practical	3.30	0.76
8.	I do not prefer group study method to case study in learning biology	3.22	0.84
9.	My teacher do not prefer computer-assisted method to lecturing method in teaching biology	3.26	0.91
10.	I do not prefer the use of role play method to discussion in learning biology	3.07	0.97
11.	My teacher allows us to brainstorm during biology lessons	3.22	0.86
12.	My teacher does not allow us to observe during practical	3.27	0.82
13.	I prefer the use of project method in learning new concepts in biology	3.26	1.02

Table 2a revealed that students generally agreed that their biology teachers employed a variety of instructional methods, with an overall weighted mean of 3.23 (above the 2.50 standard). A large majority (93.2%) noted the frequent use of the lecture method, while 81.8% indicated that computer-assisted instruction is not commonly used. Most students also reported the use of laboratory/experimental methods (90.6%), field trips (86.5%), brainstorming (85.2%), play-way methods (84.4%), project-based learning (83.4%), discussions (81.6%), and role-play (77.1%).

However, 85.8% of students indicated a preference against group studies in favor of case studies. These findings align with Shamsuddeen and Amina (2016), who emphasized the challenges of the continued reliance on lecture-based instruction by teachers.

Table 2b: Teachers' questioning

S/N	Item Statement	Mean	SD
1.	My teacher asks questions on previous biology lessons	2.17	0.89
2.	My teacher does not ask questions while teaching in biology class	1.85	0.99
3.	My teacher gives us enough time to think about the questions before answering them	1.68	1.05
4.	My teacher ask questions that allow me to critically analyse biology contents	1.52	1.01
5.	My teacher asks questions that the answer cannot be easily found in our textbooks	2.51	0.87
6.	When my biology teacher asks a question, many of our classmates are eager to answer the question	2.14	0.97
7.	When my biology teacher asks a question, many of our classmates are not eager to answer the question	3.51	0.76
8.	The questions that our biology teacher asks us during lesson help us learn new information	3.55	0.60
9.	The questions that are asked by our biology teacher are irrelevant to the topic taught in class	3.16	0.60
10.	When anyone of us has any questions to ask in our biology lessons, our teacher would ignore	3.50	0.85
11.	Our biology teacher does not answer the question for us when none of us could	3.47	0.68
12.	I don't understand the questions that our biology teacher asks us during lesson	3.61	0.71
13.	The questions our biology teacher asks are questions that require us to recall what have been previously learnt	3.61	0.56
14.	Our biology teacher allows us to ask questions	2.99	0.97
15.	Our biology teacher does not give us enough time to answer questions asked during biology lesson	3.38	0.74

Table 2b showed that students generally agreed that their biology teachers use questioning during lessons, with a weighted mean of 2.84, above the standard mean of 2.50. Most students (over 90%) confirmed that teachers ask recall-based and information-promoting questions. However, many also reported issues such as a lack of understanding of the questions (92.6%) and insufficient wait time to respond (90.9%). While a majority agreed that teachers allow student questions (70.7%), many disagreed that teachers encouraged critical thinking or provided adequate time for reflection before answering. These findings are in line with Vrikki and Evagorou (2023), who cited that to improve the effectiveness of questioning, teachers should incorporate more open-ended, authentic questions designed to encourage students to elaborate on their thinking.

Table 2c: Teachers' classroom interaction

S/N	Item Statement	Mean	SD
	Engagement		
1.	My teacher uses appropriate techniques to make us actively engaged in the class	2.53	1.01
2.	My teacher rarely engages us with projects during biology class	2.89	0.72
3.	My teacher encourages us to ask questions	3.20	0.73
4.	My teacher do not encourage us to ask questions	3.37	0.67
5.	I rarely spend time to understand the topics taught in biology class	2.79	0.80
	Feedback		
6.	My teacher spends enough time in explaining biology topics	3.05	0.67
7.	My teacher helps us to modify incorrect or inadequate	3.26	0.61
8.	The feedback given by my teacher on my set work helped to clarify things I had not fully understood in biology	3.07	0.80
9.	My teacher does not seek inputs from us about the goals of instruction.	3.39	0.60
	Teacher Talk		

10.	My teacher discusses without involving anyone in class	3.39	0.54
11.	My teacher reads from the textbook during biology lesson	2.98	0.77
12.	My teacher does not incorporate inputs from students during biology lessons	3.21	0.62
	Student Talk		
13.	I contribute to the discussions in biology class but not all the time	3.34	0.58
	Respect		
14.	My teacher treats us with courtesy and respect during biology lesson	2.88	0.88
	Teacher-student interaction		
15.	My teacher allows us to interact in every activities during the biology class	3.32	0.52
16.	I interact only when my biology teacher mandates me to do so	3.28	0.63

Table 2c presented an overall weighted mean of 3.12 out of a maximum of 4.00, indicating that most students believed their biology teachers had good classroom interaction. 98.6% of students agreed that their teachers allowed them to interact during activities, while 96.8% participated in class discussions. Additionally, 94.4% of students agreed that teachers helped modify incorrect responses. However, 90.8% of students interacted only when directed by the teacher, and 80.6% felt that teacher feedback clarified their understanding. The table also revealed that 85.0% of students rarely take time to understand topics, 79.7% noticed teachers reading from the textbook, and 74.3% felt their teachers rarely used projects. Conversely, 97.4% disagreed with the notion that their teachers discussed without involvement, and most students disagreed with teachers not seeking input, encouraging questions, or incorporating student contributions in lessons. These findings supported the study of Roorda et al. (2011), who cited that good relationships between teachers and students are important for students' academic achievement.

Table 2d: Teachers' classroom effectiveness

S/N	Item Statement	Mean	SD
	Communication Skill		
1.	My teacher maintains eye contact with students	3.07	0.91
2.	My teacher does not use gestures to emphasize or reinforce points	2.97	0.94
3.	My teacher allows students' contribution during lesson	2.95	0.93
	Use of Instructional Methods		
4.	My teacher stimulates us to apply knowledge to the discussed problem in class	3.08	0.86
5.	My teacher does not allow us interact with presented instructional materials	2.76	0.79
6.	My teacher hardly uses different instructional strategies that are effective and appropriate for each content	2.96	0.99
7.	My teacher makes use of demonstration and acting in lesson introduction and presentation	2.85	1.07
8.	My teacher does not make use of illustration during lesson introduction and presentation	3.11	0.94
	Instructional Planning		
9.	My teacher teaches with lesson notes	3.25	0.81
10.	My teacher does not explain the rules of proper classroom behaviour (ground rules) in biology lesson	3.34	0.80
11.	My teacher relates the topics logically	3.47	0.72
	Evaluation/Assessment		
12.	My teacher does assessment on topics taught during biology periods	3.42	0.81
13.	My teacher hardly gives feedback on our work to enhance learning	3.18	0.93
14.	My teacher does not always review the assignments given	2.96	1.02
	Classroom Climate/ Management		
15.	My teacher creates a positive and calm environment before discussing the biology	2.63	1.08

	contents		
16.	My teacher does not avoid distracting mannerisms	2.62	1.02
17.	My teacher manages the class skillfully during the lesson	2.62	1.06
	Subject Mastery		
18.	My teacher rarely knows the content of what he/she teaches in the class	2.57	0.83
19.	My teacher relates biology lessons to real life situations	2.59	0.94
	Praise and Rewards		
20.	My teacher reward good performance	2.51	0.85
21.	My teacher does not praise good performance	2.51	0.84
22.	My teacher hardly uses cues to indicate what answers are wrong and encourage learners to improve on poor performance	3.18	0.83

Table 2d indicates that an overall weighted mean of 2.92 out of the 4.00 maximum obtainable score is higher than the standard mean of 2.50. Most of the students agreed that their biology teachers are effective during biology classes. 73.8% and 74.0% agreed their teachers had eye contact and allowed student contributions. 76.1% agreed that teachers encouraged the application of knowledge, and 65.2% agreed with demonstrations. 85.0% and 92.2% of students agreed with teachers' instructional planning. 87.7% agreed with assessments on topics taught. 54.8% and 53.6% agreed that teachers created a positive environment and managed the class well. 61.3% agreed that lessons were related to real-life situations, while 54.3% agreed with the use of praise and rewards. These findings are in line with Muijs et al. (2014), who stated that effective teachers have a significant influence on student achievement.

Research question 3: What is the relationship between independent variables (class size and teacher classroom behaviours in terms of the use of instructional methods, questioning, classroom interaction, and teaching effectiveness) and the dependent variable (secondary school students' academic achievement in biology)?

Table 3: Correlation Matrix showing the relationship between independent variables and achievement in biology

Variables	Achievement	Class size	Use of instructional methods	Questioning	Classroom interaction	Teaching effectiveness
Achievement	1					
Class size	-0.518* 0.019	1				
Use of instructional methods	-0.016 0.687	- 0.235 0.318	1			
Questioning	0.033 0.422	0.344 0.138	-0.158* 0.000	1		
Classroom interaction	-0.069 0.092	0.287 0.220	0.040 0.330	-0.014 0.727	1	
Teaching effectiveness	-0.015 0.710	- 0.033 0.889	-0.034 0.404	-0.277* 0.000	-0.035 0.397	1
Mean	12.70	91.40	41.96	37.97	49.84	64.53
SD	57.80	98.77	6.76	5.89	5.97	9.93

*** Denotes significant at p<0.05 level of significant**

Table 3 showed a negative, moderately significant relationship between classroom size (r = -0.52; p<0.05) and students' achievement in biology. There was a negative, weak, non-significant relationship between the use of instructional methods and students' achievement in biology (r = -0.02; p>0.05). There was a positive, weak, non-significant relationship between teacher questioning and students' achievement in biology (r = 0.03; p>0.05). The relationship between classroom interaction and students' achievement in biology was negative and not significant (r = -0.07; p>0.05). There was a negative, weak non-significant relationship

between teaching effectiveness and students' achievement in biology (r = -0.02; p>0.05). This result negated the findings of Kang'ahi et al. (2012) and Kangsepp (2011) on the effect of instructional methods and questioning on student understanding and achievement.

Research question 4: What are the joint effects of class size and the teachers' classroom behaviours (use of instructional methods, questioning, classroom interaction, and teaching effectiveness) on secondary school students' academic achievement in biology?

Table 4: Multiple Regression Analysis showing the composite contribution of teacher classroom behaviours to students' achievement in biology

Sources of Variance	Sum of Squares	Df	Mean Square	F	Significant
Regression	32.654	5	6.531	2.336	0.097
Residual	39.146	14	2.796		
Total	71.800	19			
R = 0.674 R Square = 0.455 Adjusted R Square = 0.260 Standard error of the Estimate = 1.67218					

Table 4 showed that the composite contribution of independent variables (class size and teachers' classroom behaviours in terms of the use of instructional methods, questioning, classroom interaction, and teaching effectiveness) to students' achievement in biology was not significant ($F_{(5,14)} = 2.34$; Adj $R^2 = 0.26$; p>0.05). These findings revealed that the class size and teachers' classroom behaviours, when measured together, do not predict students' achievement in biology.

Research question 5: What is the relative contribution of class size and teacher classroom behaviours (use of instructional methods, questioning, classroom interaction, and teaching effectiveness) on secondary school students' academic achievement in biology?

Table 5: Multiple Regression Analysis showing relative contributions of independent variables to students' achievement in biology

Model	Understandardized Coefficients		Standardized Coefficient	Rank	T	Sig.
	Beta	Std. Error	Beta (β)			
(Constant)	7.052	6.878			1.025	0.323
Class size	-0.012	0.004	-0.614	1st	-2.765	0.015*
Use of instructional methods	-0.046	0.101	-0.098		-0.450	0.660
Questioning	-0.066	0.107	-0.146		-0.612	0.550
Classroom interaction	0.009	0.041	0.052		0.217	0.831
Teaching effectiveness	0.156	0.090	0.432		1.728	0.106

Table 5 showed that the relative contribution of class size (β = -0.61; t = -2.77; p<0.05) to students' academic achievement in biology was significant. The relative contributions of the use of instructional methods (β = -0.10; t = -0.45; p>0.05), teacher questioning (β = -0.15; t = -0.61; p>0.05), classroom interaction (β = 0.05; t = 0.22; p>0.05), and teaching effectiveness (β = 0.43; t = 1.73; p>0.05) to students' academic achievement in biology were not significant.

Research question 6:

Table 5 showed the prediction power of students' variables (class size and the teacher's classroom behaviour) to students' academic achievement in biology at different levels and ranks as expressed by the β-values. Many of the participants performed poorly in the biology student achievement test (BSAT). These findings indicated that class size is a potent student variable that predicts students' academic achievement in biology. This means that for students' achievement in biology to improve, class size needed to be reduced. These findings aligned with Azigwe et al.'s (2016) study, which highlighted the challenges teachers faced in effectively teaching large classes,

potentially resulting in reduced student engagement and learning outcomes. They also corroborate Bosworth's (2014) findings, indicating that larger class sizes negatively impact student performance.

Conclusion

The study examined the relative and joint contribution of class size and teachers' classroom behaviours on secondary school students' achievement in biology and found that class size is an important variable and should be properly considered to ensure effective teaching and learning and to improve the success rate of students in biology. Also, it is concluded that these classroom behaviours do not influence students' academic achievement in biology. Therefore, there is a need for educational bodies, the government, and teachers to ensure that the class sizes are reduced and that each biology class follows the recommendation of the National Policy on Education on a class size with an average of forty (40) students.

Recommendations

Based on the findings, this study recommended that:

1. Class size should be reduced, and it was recommended that schools should comply with the 40:1 student-teacher ratio as stipulated by the National Policy on Education. For class sizes that cannot be reduced due to challenges beyond the school authorities, the school management should employ rotational student groups for study.
2. Teachers should deemphasize the traditional method of teaching characterized by lecture methods and employ different methods and strategies, such as collaborative learning, inquiry-based instruction, project-based learning, and differentiated instruction, that are appropriate to meet the learners' needs. The use of computer-assisted instruction should be encouraged as part of the teaching and learning process.
3. Curriculum experts and planners should ensure that the curriculum is organized in ways that appropriate strategies and methods will address the inflated class size and improve students' academic achievement.

References

Agboghoroma, T. E., & Oyovwi, E. O. (2015). Evaluating the effect of students' academic achievement on identified difficult concepts in senior secondary school biology in Delta State. *Journal of Education and Practice, 6*(30), 117–125.

Alebiosu, K. A. (2012). Spicing up science instruction: The choices and the chances. *54th Inaugural lecture of Olabisi Onabanjo University.*

Ali, A. R., Toriman, M. E., & Gasim, M. B. (2014). Academic achievement in biology with suggested solutions in selected secondary schools in Kano State, Nigeria. *International Journal of Education and Research, 2*(11), 215–224.

Ali, F. A., & Chacko, M. (2013). A comparison of cooperative learning models on academic achievement. *Journal of Applied Science, 7*(1), 137–140.

Arokoyu, A. A., & Chukwu, J. C. (2017). Biology teachers' methods of teaching and academic performance of secondary school students in Abia State, Nigeria. *Journal of Emerging Trends in Educational Research and Policy Studies, 8*(4), 228–231.

Ashimole, A. U. (2011, September 5–8). Developing teaching manpower through emerging myths and realities in Nigeria institutions. International Conference on Teaching, Learning, and Change, International Association for Teaching and Learning (IATEL).

Azigwe, J. B., Kyriakides, L., Panayiotou, A., & Creemers, B. P. M. (2016). The impact of effective teaching characteristics in promoting student achievement in Ghana. *International Journal of Educational Development, 51*, 51–61. https://doi.org/10.1016/j.ijedudev.2016.07.004

Barnett, J. E., & Francis, A. L. (2012). Using higher order thinking questions to foster critical thinking: A classroom study. *Educational Psychology*, 32(2), 201–211. https://doi.org/10.1080/01443410.2011.638619.

Bichi, A. A., Ibrahim, F. B., & Ibrahim, R. H. (2019). Assessment of students' performances in biology: Implications for measurements and evaluation of learning. *Journal of Education and Learning, 13*(3), 301–308. https://doi.org/10.11591/edulearn.v13i3.12200

Borich, G. D. (2004). *Effective teaching methods* (5th ed.). Pearson Merrill Prentice Hall.

Bosco, N. J., Ntawiha, P., & Alexis, A. (2023). Factors contributing to students' academic performance in biology state examination at upper secondary schools in Gitega Commune, Gitega Province in Burundi. *Universal Journal of Educational Research*, 2(3), 191-203.

Bosworth, R. (2014). Class size, class composition, and the distribution of student achievement. *Education Economics*. 22(2): 141-165.

Chika, P. O. (2012). The extent of students' responses in the classroom. *International Journal of Academic Research in Business and Social Sciences, 2*(1), 22–37.

Ehebha, G. A., & Adeyinka, O. L. (2022). Influence of classroom sizes on biology students' educational achievements. *International Journal of Innovative Science and Research Technology, 7*(7), 241–245.

Fakolade, B. A., Ale, M. D., Oluwatosin, C. O., Ogunbiyi, O. J., Oyekunle, S. O., & Asogwa, B. C. (2024). Survey of teacher–students' classroom interaction patterns on students' achievement and interest in senior secondary school biology in Makurdi, Benue State, Nigeria. *Global Scientific and Academic Research Journal of Education and Literature*, *2*(7), 36–42.

Federal Republic of Nigeria (2004). *National policy on education* (4th ed.). Lagos: Nigerian Educational Research and Development Council.

Federal Republic of Nigeria (2014). National policy on education. Abuja: NERDC Press.

Felder, R. M. (2013). Reaching the second tier learning and teaching styles in colleges. *Education Journal of College Science Teaching, 23*(2), 286–290.

Ibe, E. (2013). Effects of constructivist instructional model on scientific literacy levels and interest of upper basic science students (Unpublished doctoral thesis). University of Nigeria, Nsukka.

Kang'ahi, M., Indoshi, F.C., Okwach, T.O., & Osodo, J. 2012. Teaching styles and learners' achievement in Kiswahili language in secondary schools. *International Journal of Academic Research in Progressive Education and Development*, 1(3), 62-82.

Kängsepp, P. (2011). Impact of asking support questions on grades 4 and 7 students' reading comprehension. *Creative Education, 2*(4), 381–387.

Kedney, R. J. (2013). Performance measurement in non-advanced further education: The use of statistics (Unpublished doctoral thesis). University of Lancaster, United Kingdom.

Maulana, R., Helms-Lorenz, M., & Van de Grift, W. (2015). Students' perception of teaching behaviour: Evaluation of an instrument and importance of academic motivation in Indonesian secondary education. *International Journal of Educational Research, 69*, 98–112. https://doi.org/10.1016/j.ijer.2014.11.002

McLure, F. I., Fraser, B. J., & Koul, R. B. (2022). Structural relationships between classroom emotional climate, teacher–student interpersonal relationships and students' attitudes to STEM. *Social Psychology of Education, 25*, 625–648. https://doi.org/10.1007/s11218-022-09694-7

Muijs, D., Kyriakides, L., van der Werf, G., Creemers, B., Timperley, H., & Earl, L. (2014). State of the art – teacher effectiveness and professional learning. *School Effectiveness and School Improvement*, *25*(2), 231–256. https://doi.org/10.1080/09243453.2014.885451

Nwoke, E. S., Uitto, A., & Lavonen, J. (2022). A comparative study of upper secondary school biology curricula in two countries: Finland and Nigeria. *Science Education International, 33*(1), 38–49. https://doi.org/10.33828/sei.v33.i1.4

Olagunju, A. M., & Babayemi, J. O. (2014). Effects of enhanced explicit teaching and peer-tutoring strategy and gender on students' attitude to basic science. Department of Teacher Education, University of Ibadan, Nigeria.

Ose-Aigbekaen, S., & Osasogie, S. (2020). A survey of the characteristics of the new senior secondary school biology curriculum. *African Journal of Science, Technology and Mathematics Education, 5*(1), 87–93.

Panayiotou, A., Kyriakides, L., Creemers, B. P. M., Charalambous, E., & Demetriou, D. (2014). Teacher behaviour and student outcomes: Results of a European study. *Educational*

Assessment, Evaluation and Accountability, 26(1), 73–93. https://doi.org/10.1007/s11092-013-9182-x

Peterson, D. S., & Taylor, B. M. (2012). Using higher order questioning to accelerate students' growth in reading. *The Reading Teacher, 65*(5), 295–304.

Roorda, D. L., Koomen, H. M. Y., Spilt, J. L., & Oort, F. J. (2011). The influence of affective teacher–student relationships on students' school engagement and achievement: A meta-analytic approach. *Review of Educational Research, 81*(4), 493–529. https://doi.org/10.3102/0034654311421793

Ruffina, A. N., Esther, A. E., & Anastecia, I. N. (2018). Impact of class size on students' academic performance in biology in Idemili North Local Government Area of Anambra State. *International Journal of Education and Evaluation, 4*(8), 1–8.

Shamsuddeen, A., & Amina, H. (2016). Instructional methods and students' end of term achievement in Biology in selected secondary schools in Sokoto Metropolis, Sokoto State, Nigeria. *Journal of Education and Practice*, *7*(32), 198-204.

Telli, S., den Brok, P., & Cakiroglu, J. (2010). The importance of teacher–student interpersonal relationships for Turkish students' attitudes towards science. *Research in Science & Technological Education, 28*(3), 261–276. https://doi.org/10.1080/02635143.2010.501750

Teodorović, J., Milin, V., Bodroža, B., Đerić, I. D., Vujačić, M., Jakšić, I. M., Stanković, D., Cankar, G., Charalambous, C. Y., Van Damme, J., & Kyriakides, L. (2021). Testing the dynamic model of educational effectiveness: The impact of teacher factors on interest and achievement in mathematics and biology in Serbia. *School Effectiveness and School Improvement, 33*(1), 51–85. https://doi.org/10.1080/09243453.2021.1942076

Vrikki, M., & Evagorou, M. (2023). An analysis of teacher questioning practices in dialogic lessons. *International Journal of Educational Research*, *117*, 102107. https://doi.org/10.1016/j.ijer.2022.102107

West African Examination Council. (2014–2024). *Senior school certificate examiner's report*. Lagos.