2026 Volume: 02 Issue: 09 www.ijrpa.com ISSN 2456-9995 Research Article

International Journal Research Publication Analysis

Page: 01-20

THE INFLUENCE OF LARGE CLASS SIZE ON THE EFFECTIVE TEACHING AND LEARNING OF CHEMISTRY IN SECONDARY SCHOOLS

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Article Received: 30 July 2026

Article Revised: 20 August 2026

Published on: 10 September 2026

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DOI: https://doi-doi.org/101555/ijrpa.4134

ABSTRACT

This study investigated the influence of large class size on the effective teaching and learning of Chemistry in secondary schools in Onitsha North Local Government Area of Anambra State, Nigeria. The study was guided by four purposes and four corresponding research questions, examining class size's influence on teaching, learning, classroom interaction, and teacher support during Chemistry lessons. A descriptive survey design was adopted. The population comprised 2,605 Senior Secondary Two (SS2) Chemistry students and 67 Chemistry teachers across sixteen public secondary schools in the study area. Using simple random sampling, ten schools were selected, yielding a sample of 180 students and 20 teachers (200 respondents in total). Data were collected using a structured, researcher-developed questionnaire (Cronbach's alpha = 0.85) and analysed using mean and standard deviation, with a criterion mean of 2.50 for acceptance. Findings indicated that while large class size showed a mixed, largely non-significant relationship with teaching practice itself (cluster mean = 2.33), it was found to negatively affect student learning (cluster mean = 3.32), classroom interaction (cluster mean = 2.48), and the level of individualised teacher support students received (cluster mean = 2.92). The study concludes that large class size is a substantive barrier to effective Chemistry instruction, particularly in relation to student learning outcomes and the quality of teacher-student engagement, and recommends policy attention to classroom capacity, teacher recruitment, and differentiated instructional strategies as viable responses.

KEYWORDS: Class size, Chemistry Education, Secondary School, Teaching Effectiveness, Classroom Interaction, Nigeria.

1. INTRODUCTION

1.1 Background of the Study

Science has been embraced as a driver of the modern world and a catalyst for national civilisation. It has been described as a discipline branded by a systematic approach to seeking and organising knowledge, and for any nation to benefit fully from the opportunities science offers, a substantial level of scientific literacy is required among its citizens (Pember & Humbe, 2009). Science plays an important role in society because it relates directly to daily life and career development, and the importance of science education led the Federal Government of Nigeria, through the Federal Ministry of Education, to introduce science subjects — including Chemistry — into the secondary school curriculum.

Chemistry occupies a unique position among the science subjects offered at the senior secondary level. Its study involves a pursuit of truth that instils diligence, patience, and objectivity in learners (Opara & Waswa, 2013), and it develops scientific habits — critical thinking, non-reliance on superstition, and respect for others' views — that transfer to other areas of life (Yunus & Ali, 2012). Chemistry is a fundamental requirement for most core science-based courses (Oloyede, 2010), which makes students' academic achievement in the subject a central concern of educational research. Alongside student and home factors, school-level variables — including class size — have consistently been identified as influencing academic achievement, positively or negatively.

Class size refers to the number of students for whom a teacher is primarily responsible during a school year (Adeyemi, 2008), and functions similarly to the administrative concept of 'span of control' — the number of subordinates a manager can effectively supervise (Micheal, 2010). It is widely perceived that smaller classes produce fewer disruptions and better teacher-student engagement than larger ones; Hattie (2009) argued that it is not interaction per se but effective interaction that drives learning, and Sparks (2010) characterised a class as large once enrolment exceeds 25 students. As global and national school populations continue to grow, class size has increasingly been recognised in the literature as affecting student feelings, performance, school budgets, and administration (Owoeye & Yara, 2011), even though it remains a variable over which individual teachers have little direct control.

Evidence on the relationship between class size and achievement remains contested. While conventional wisdom among parents, teachers, and policymakers holds that smaller classes improve learning outcomes, this view has not been universally supported (Aturupane, Glewwe & Wisniewski, 2013). At the same time, large intake numbers carry practical benefits for schools and government, notably reducing the cost of constructing additional classrooms — a resource constraint many Nigerian schools and local governments face. Determining an 'ideal' class size therefore continues to generate debate, particularly amid population growth, financial hardship, and teacher shortages. Several factors — inadequate school infrastructure, population growth, and an insufficient number of subject teachers — combine to produce larger class sizes, requiring teachers to manage students with diverse personalities, backgrounds, and abilities within a single classroom (Eboatu & Ehirim, 2018).

1.2 Statement of the Problem

In Onitsha North Local Government Area, Anambra State, inadequate classroom infrastructure is compounded by a shortage of Chemistry teachers, driven in part by retirements that go unreplaced. This has increased teacher-student ratios and, in some schools, led to the combination of two or more classes for Chemistry instruction due to a lack of specialist teachers. The resulting large class formations are associated with congestion, noise, and reduced interpersonal contact between teachers and students. In a Chemistry class with a 50:1 student-teacher ratio, some students are unable to hear instruction clearly, resulting in poor dissemination of content and limited comprehension of the topic under discussion. This study was therefore designed to investigate the influence of large class size on the effective teaching and learning of Chemistry in secondary schools in Onitsha North Local Government Area of Anambra State.

1.3 Purpose of the Study

The purpose of this study was to investigate the influence of large class size on the effective teaching and learning of Chemistry in secondary schools in Onitsha North Local Government Area. Specifically, the study sought to:

- Determine the influence of large class size on the teaching of Chemistry in secondary schools.
- Determine the influence of large class size on the learning of Chemistry in secondary schools.
- Determine the influence of large class size on classroom interaction during Chemistry lessons.
- Determine the influence of large class size on teacher support to students during Chemistry lessons.

1.4 Research Questions

- What is the influence of large class size on the teaching of Chemistry in secondary schools?

- What is the influence of large class size on the learning of Chemistry in secondary schools?
- What influence does class size have on classroom interaction during Chemistry lessons in secondary schools?
- What influence does class size have on teacher support during Chemistry lessons in secondary schools?

1.5 Significance of the Study

The findings of this study are expected to benefit both students and Chemistry teachers. For students, the findings may enhance the learning experience by fostering deeper understanding, improved engagement, and increased motivation, particularly where findings are disseminated through seminars, conferences, and school libraries. For teachers, the findings may support the identification of areas for instructional improvement, ultimately promoting stronger student engagement and learning outcomes when the study is made available for professional reading and application.

1.6 Scope of the Study

The study was conducted in public secondary schools in Onitsha North Local Government Area, Onitsha Education Zone, Anambra State, and was limited to Chemistry teachers and Senior Secondary Two (SS2) Chemistry students within that area. Public schools only were sampled, to ensure uniformity of conditions across the study population.

2. Literature Review

This review is organised under three headings: conceptual framework, theoretical framework, and empirical review.

2.1 Conceptual Framework

Concept of Chemistry

Chemistry is a key science subject that explains the workings of the universe through the properties and interactions of matter (Owoyemi & Adesoji, 2012), and is essential to medicine, clothing, housing, oil exploration, food production, and storage. According to Njelita and Emendu (2015), Chemistry is at the core of every technology, functioning as a gatekeeper subject for further study in pure and applied science, medicine, pharmacy, engineering, agriculture, nursing, and food technology. Chemistry as a science subject is activity-oriented, and the guided-discovery method has been recommended as its most suitable, resource-based teaching approach (NTI, 2018).

Concept of Class Size

Class size is the number of students a teacher attends to during a given period of instruction (Eboatu & Ehirim, 2018), distinct from the student-teacher ratio, which reflects the relationship between total student population and total teacher numbers school-wide and can mask subject-specific teacher shortages. The Federal Republic of Nigeria (FRN, 2013) prescribes a student-teacher ratio of 1:25 for pre-primary, 1:35 for primary, and 1:40 for secondary classes. In practice, large and overpopulated classes are associated with student disengagement (Eboatu & Ehirim, 2018), reduced individual attention, and consequent risk of poor academic achievement.

Class Size, School Discipline, and Performance

Classroom discipline concerns the enforcement of classroom standards and the building of cooperative patterns that maximise learning and minimise disruption (Animashaun, 2009). A recurring argument in the literature attributes classroom indiscipline in part to class size — that classes become too large for a teacher to manage effectively (Mcintyre, 2005). Findings on the precise relationship between class size, discipline, and academic performance remain divided, though several Nigerian studies (e.g., Fabunmi, Brai-Abu & Adeniji, 2007; Tobih, Akintaro & Osunlana, 2013) report a significant relationship between class size and student academic performance.

Status of Class Size in Senior Secondary Chemistry Classes

Nigeria's adoption of Education for All (EFA) policy has, alongside broader global enrolment trends, driven substantial growth in student numbers at all education levels, including Chemistry. The FRN (2013) recommends an average of 40 students per class as the national standard; classes with 41 or more students are generally categorised as large, and those with 15–40 as small (Aliu, 2015). Rising enrolment without corresponding infrastructure expansion has left many Chemistry teachers managing more students than they can effectively support, reducing individual attention, disciplinary control, and the feasibility of thorough continuous assessment.

Large Class Size and Academic Achievement of Chemistry Students

Teaching large classes presents particular pedagogical challenges, especially where schools face concurrent budget constraints that limit their capacity to build additional classrooms or hire additional teachers. The literature suggests that pedagogical strategies designed for smaller classes do not transfer directly to larger ones, requiring distinct instructional approaches (Aturupane et al., 2013; Azigwe, Kyriakides, Panayiotou & Creemers, 2016). While no firm consensus exists on the exact threshold that defines a 'large' class, the term is generally applied to classes exceeding 50 students, with some scholars reserving it for classes above 100 (Amadahe, 2016).

Assessment and feedback represent one of the most consistently reported strains of large-class teaching. Large classes generate substantial volumes of marking, and teachers frequently report being unable to complete marking of assignments, exercises, and examinations promptly, which delays the feedback students receive and, in turn, weakens the formative value of assessment (Amadahe, 2016). Faced with this workload, instructors often default to traditional, less individualised assessment methods; Kasumi (2014) observed that large classes are less likely to use compositions or oral presentations and more likely to rely on multiple-choice examinations, which reduce opportunities to assess higher-order reasoning.

Olatunde (2010), in a study of class size and academic achievement in mathematics in Southwestern Nigeria, found that students in large classes achieved a pass rate of only 23%, compared to 64% among students in smaller classes — one of the starkest quantitative illustrations in the literature of the achievement gap associated with class size. Beyond academic performance, large classes have also been found to affect students' psychological experience of learning: many students, particularly those newly transitioning into a subject, report feeling anonymous within a large class, which can reduce motivation, while the presence of many peers can make students feel too intimidated to ask questions or seek help (Tomlinson, 1998). Compounding this, inadequate seating and desking in some Nigerian secondary schools means students in large classes are sometimes without adequate furniture altogether (Oyeniran, 2014), a material constraint layered on top of the pedagogical ones already discussed.

2.2 Theoretical Framework

Bandura's Social Learning Theory

Albert Bandura's Social Learning Theory (1977) proposes that behaviour is learned from the environment through observational learning, positioning human beings as active information processors who reflect on the relationship between their behaviour and its consequences, rather than passive recipients of conditioning. Bandura maintained that observational learning could not occur without accompanying cognitive processing, and demonstrated through his well-known 'Bobo doll' experiments that children learn and imitate behaviours they observe in influential 'models' around them — parents, peers, media figures, and teachers.

Three basic models of observational learning were identified: the symbolic model (behaviour displayed by real or fictional characters in books, film, television, or online media), the live model (an actual individual demonstrating a behaviour), and the verbal instructional model (descriptions and explanations of a behaviour). Bandura also introduced the concept of intrinsic reinforcement — internal rewards such as pride, satisfaction, and a sense of accomplishment — and distinguished learning from behaviour change, noting that observational learning can produce new knowledge without an accompanying, immediately observable change in behaviour.

This theory is relevant to the present study because classroom size directly shapes how much modelling and observational learning a Chemistry teacher can realistically provide — in a large class, opportunities for students to observe a teacher's live demonstration closely, receive individualised verbal instruction, or have their attempts at imitation corrected are all proportionally reduced, weakening the observational learning pathway Bandura identified as central to how students acquire new behaviours and skills.

Piaget's Theory of Cognitive Development

This study draws on Piaget's Theory of Cognitive Development, particularly the Formal Operational Stage (approximately ages 11–16), which is most directly relevant to senior secondary school learners. At this stage, learners are capable of abstract, propositional thought — reasoning about hypothetical and possible situations rather than only concrete, observed ones — a cognitive capacity central to understanding chemical concepts that require reasoning about unobservable particles and processes. Piaget characterized cognitive growth as relative, functional, dialectical, and intrinsic: new information is assimilated and accommodated relative to a learner's existing knowledge structures, occurring most effectively when new material is only slightly more complex than what the learner already knows.

The theory's relevance to this study lies in its implication for instructional design: teachers should adopt child-centered, activity-oriented instruction that challenges students' reasoning and supports cognitive growth through manipulation and direct engagement — conditions that become materially harder to sustain as class size increases and individual teacher attention per student correspondingly decreases.

2.3 Empirical Review

Deyale, Gokum, and Odeyale (2018) examined the effect of large class size on teachers' lesson delivery and students' classroom participation among 50 junior secondary school teachers in the Abuja Municipal Area Council. Using structured, expert-validated questionnaires and descriptive analysis, the study found that large classes dominated the junior secondary level and that teachers faced substantial difficulty across nearly every dimension of classroom management — 90% reported difficulty achieving classroom control, 96% difficulty attending to individual student needs, and 94% difficulty moving around the classroom during lessons. The study recommended a policy cap of 30 students per teacher.

Olowe (2021) investigated the implications of large class size for the teaching and learning of Business Education in tertiary institutions in Ekiti State, surveying 30 lecturers and 520 final-year students across three institutions. The study found that large class size had negative implications for effective teaching and learning, with a weak overall relationship between class size and instructional effectiveness, and recommended increased staffing and resource provision.

Dolphus and Godgift (2019) examined the influence of class size on the teaching and learning of Basic Science among 223 students and 17 teachers in Port Harcourt metropolis, using a descriptive survey design and a purposive sample. The study found that small class sizes positively influenced teaching and learning, while large classes had the opposite effect, and recommended reduced class enrolment to facilitate collaboration and communication.

Mahlo (2015) compared class size between boarding and non-boarding schools in the Capricorn District, Limpopo Province, South Africa, drawing on a sample of 51 principals, 158 teachers, and 290 learners across 51 schools. Using t-test analysis, the study found no statistically significant relationship between class size and academic achievement — a finding that diverges from much of the Nigerian literature reviewed above and illustrates that the class-size–achievement relationship is not uniform across educational contexts.

2.4 Summary of Literature Review and Gap

The reviewed literature establishes that class size is a widely studied but contested variable in education research, with most Nigerian studies reporting a negative relationship between large class size and effective teaching and learning, while some international studies (e.g., Mahlo, 2015) find no significant relationship. The review found no empirical study directly examining the influence of class size on the effective teaching and learning of Chemistry specifically among secondary school students in Onitsha North Local Government Area of Anambra State, establishing the gap this study was designed to address.

3. METHODOLOGY

3.1 Research Design

The study adopted a descriptive survey research design, appropriate for collecting and systematically describing data on the influence of large class size on Chemistry teaching and learning without manipulating any variable (Nworgu, 2015).

3.2 Area of the Study

The study was conducted in Onitsha North Local Government Area of Anambra State, South-East Nigeria, encompassing Omagba Layout Phases 1 and 2, Inland Town, GRA, Federal Housing Estate Trans-Nkisi GRA, Akpaka, Odoakpu, and Ose.

3.3 Population of the Study

The population comprised all Senior Secondary Two (SS2) Chemistry students and Chemistry teachers across the sixteen public secondary schools in Onitsha North Local Government Area — a total of 2,605 SS2 Chemistry students and 67 Chemistry teachers (Post Primary Schools Service Commission, Onitsha Education Zone, 2024).

3.4 Sample and Sampling Technique

Simple random sampling was used to select ten of the sixteen public secondary schools in the study area. From each selected school, 18 Chemistry students and 2 Chemistry teachers were sampled using the same technique, yielding a total sample of 180 SS2 Chemistry students and 20 Chemistry teachers — 200 respondents in total.

3.5 Instrument for Data Collection

Data were collected using a structured, researcher-developed questionnaire titled 'Questionnaire on the Influence of Large Class Size on the Effective Teaching and Learning of Chemistry in Secondary School' (QILCSETLCSS), constructed around the study's four research questions using a four-point rating scale.

3.6 Validation of the Instrument

The instrument was face-validated by three experts — two from the Chemistry Education unit and one from Measurement and Evaluation, all at Nwafor Orizu College of Education, Nsugbe — for clarity, correct wording, and adequacy in addressing the study's purpose and problem. Their observations and corrections were incorporated into the final instrument.

3.7 Reliability of the Instrument

The instrument was trial-tested on 20 Chemistry students and 8 Chemistry teachers in Onitsha South Local Government Area — sharing similar characteristics with the study area but excluded from the main study. Internal consistency was computed using Cronbach's Alpha, yielding a reliability coefficient of 0.85, indicating that the instrument was reliable for the non-dichotomously scored items used.

3.8 Method of Data Collection

Questionnaires were distributed directly to respondents during school hours, with researchers providing clarification where necessary and ensuring immediate return of completed instruments.

3.9 Ethical Considerations

Respondents were informed, via a cover letter accompanying the questionnaire, of the purpose of the study and their role as final-year researchers conducting it. Participation was voluntary, and respondents were assured that information supplied would be treated with confidentiality and that their anonymity would be preserved throughout data collection, analysis, and reporting. No identifying information beyond respondent name and school (optional, Section A of the instrument) was collected, and no individual-level responses are reported in this manuscript — only aggregated means and standard deviations by item and research question.

3.10 Method of Data Analysis

Research questions were answered using mean and standard deviation. Interpretation followed real limits of numbers: a mean of 3.50–4.50 was interpreted as Strongly Agreed (SA), 2.50–3.49 as Agreed (A), 1.50–2.49 as Disagreed (D), and 0.50–1.49 as Strongly Disagreed (SD). Any item with a mean of 2.50 or above was accepted; items below 2.50 were rejected.

4. RESULTS

4.1 Research Question One: Influence of Large Class Size on the Teaching of Chemistry

Table 1: Mean and Standard Deviation on the Influence of Large Class Size on the Teaching of Chemistry.

S/N	Statement	X	SD	Decision
1	Large class size affects the pace of the lessons in class.	2.24	1.09	Disagreed
2	Teachers are able to identify students who have difficulties in understanding the main ideas of a lesson.	2.52	1.11	Agreed
3	Large class size increases the time teacher spent on handling	2.23	0.837	Disagreed

	non-instructional tasks.			
4	Teachers spend a lot of time controlling students rather than teaching.	1.99	0.713	Disagreed
5	Teachers are able to assess the instructional needs of students.	2.53	1.12	Agreed
6	Teachers are able to assess the emotional needs of students.	2.52	1.11	Agreed
	Cluster Mean	2.33	0.997	

Items 1, 3, 4, and 6 recorded mean scores in the disagreed range (1.50–2.49), while items 2 and 5 fell in the agreed range (2.50–3.49). The overall cluster mean of 2.33 (SD = 0.997) indicates that respondents, on balance, disagreed that large class size directly influences the teaching of Chemistry itself — a more mixed finding than for the outcomes examined in subsequent research questions. Notably, items relating to teachers' capacity to assess students' instructional and emotional needs (items 5 and 6) scored just above the acceptance threshold, suggesting that while teachers in large classes may retain some diagnostic awareness of student needs, this does not necessarily translate into a change in how lessons are paced or delivered (items 1 and 3, both disagreed).

4.2 Research Question Two: Influence of Large Class Size on the Learning of Chemistry

Table 2: Mean and Standard Deviation on the Influence of Large Class Size on the Learning of Chemistry.

S/N	The implication of large class size on learning	X	SD	Decision
1	Large class affects student assimilation.	3.48	0.98	Agreed
2	It is an avenue to interact instead of learning.	3.08	0.83	Agreed
3	Information from the teacher will not be properly disseminated.	3.48	0.92	Agreed
4	High cases of examination failure in large class.	3.32	0.91	Agreed
5	Interference from unserious students affects learning in a large class.	3.40	1.07	Agreed
6	No motivation to attend classes.	3.36	0.90	Agreed
7	Opportunity for students to exhibit unruly behaviour due to inability of teacher to control students.	3.24	0.95	Agreed
8	Facilities to enhance learning are not available in a large class.	3.40	0.88	Agreed
9	Regular lateness for lectures.	3.00	0.84	Agreed
10	Students are less attentive in large class size.	3.44	0.83	Agreed
	Cluster Mean	3.32	0.91	

All ten items recorded mean scores in the agreed range (2.50–3.49), yielding a cluster mean of 3.32 (SD = 0.91). This indicates a clear, consistent finding that large class size negatively affects student learning of Chemistry, including assimilation, dissemination of information, examination performance, motivation, and attentiveness. The consistency across all ten items

— unlike the more mixed pattern observed for Research Question One — is itself notable: it suggests that whatever adaptive capacity teachers retain in large classes (as reflected in Table 1), it is not sufficient to protect the actual learning outcomes students experience. The highest-scoring items were 'large class affects student assimilation' and 'information from the teacher will not be properly disseminated' (both X = 3.48), pointing to a breakdown specifically at the point of information transfer from teacher to student, rather than in the teacher's underlying content knowledge or lesson preparation.

4.3 Research Question Three: Influence of Large Class Size on Classroom Interaction

Table 3: Mean and Standard Deviation on the Influence of Large Class Size on Classroom Interaction.

S/N	Item	X	SD	Decision
1	High rate of negative peer group influence in large class size.	3.18	0.57	Agreed
2	Positive peer group influence in large class size.	1.82	1.06	Disagreed
3	There is effective student-teacher interaction in large class.	1.90	0.89	Disagreed
4	Large class size makes teaching and learning of Chemistry long and boring.	3.12	0.88	Agreed
5	Students tend to feel anxious and uncomfortable due to the crowd in large class size.	2.80	1.16	Agreed
6	Large class size gives room for effective interaction.	1.70	0.45	Disagreed
7	Students hardly see writings on the board when seated at the back in a large class.	3.66	0.35	Agreed
8	Students in large class size get proper view of the board.	2.30	0.46	Disagreed
9	Teachers easily identify students who need extra tuition and attention during lesson period in large class size.	1.92	0.26	Disagreed
	Cluster Mean	2.48	0.67	

Items 2, 3, 6, 8, and 9 fell in the disagreed range, while items 1, 4, and 5 fell in the agreed range; item 7 recorded a mean of 3.66, in the strongly agreed range. The cluster mean of 2.48 (SD = 0.67) indicates that, on balance, large class size is associated with ineffective classroom interaction during Chemistry lessons.

4.4 Research Question Four: Influence of Class Size on Teacher Support

Table 4: Mean and Standard Deviation on the Influence of Large Class Size on Teacher Support During Chemistry Lessons.

S/N	Item	X	SD	Decision
1	Large class sizes allow more time for teachers to help students during practical sessions in Chemistry.	1.73	0.85	Disagreed
2	Teachers provide optimum support for students with learning disabilities in large classes.	1.96	0.17	Disagreed
3	There is adequate field trip planning and organization in large class size.	3.10	0.87	Agreed
4	Inability of teachers to effectively guide students during Chemistry experiments in large class size.	3.95	0.22	Agreed
5	The objectives for students' presentation cannot be achieved in large class size.	3.88	0.28	Agreed
	Cluster Mean	2.92	0.48	

Items 1 and 2 fell in the disagreed range, while items 3, 4, and 5 fell in the agreed range. The cluster mean of 2.92 (SD = 0.48) indicates that teachers do not provide optimum support to students during Chemistry lessons in large classes.

4.5 Summary of Major Findings

- The influence of large class size on the teaching of Chemistry in secondary school, taken alone, was disagreed (cluster mean = 2.33).
- Large class size negatively influences the learning of Chemistry (cluster mean = 3.32).
- Large class size is associated with ineffective classroom interaction during Chemistry lessons (cluster mean = 2.48).
- Teachers do not provide optimum support to students in large classes during Chemistry lessons (cluster mean = 2.92).

5. DISCUSSION

5.1 Influence of Large Class Size on the Teaching of Chemistry

Although the cluster mean for this research question fell in the disagreed range, several individual items — teachers' ability to assess students' instructional and emotional needs — scored in the agreed range, suggesting a more nuanced picture than a simple negative relationship. Where the broader literature (e.g., Olowe, 2021; Kobina, 2021) reports a clearly negative relationship between class size and teaching itself, the present findings suggest that Chemistry teachers in this context may retain some capacity to adapt their teaching approach even under large-class conditions, while still facing substantial strain in other respects — a distinction the subsequent research questions clarify further.

5.2 Influence of Large Class Size on the Learning of Chemistry

The finding that large class size negatively affects student learning is the strongest and most consistent result in this study, aligning with Glass and Smith's (2019) finding that increasing class size is associated with decreased academic performance. Large classes were found to impair assimilation, reduce the effectiveness of information dissemination, contribute to examination failure, and reduce motivation and attentiveness — consistent with Altinok and Kingdon (2012) and Bosworth (2014), who found that individualised, feedback-rich pedagogies are difficult to sustain in large classes. This finding diverges from Barcca and Fredua (2008), who characterised the evidence linking class size to learning outcomes as inconclusive; the present study's Chemistry-specific, Nigerian secondary-school context may explain this divergence, given the subject's dependence on close teacher guidance during abstract and practical instruction.

5.3 Influence of Large Class Size on Classroom Interaction

The finding of ineffective classroom interaction in large classes, including a high rate of negative peer influence and reduced teacher capacity to identify students needing additional support, is consistent with Miller and Cunningham (2011), who found that teachers who maintain respectful, well-managed classrooms are better able to sustain high learning expectations — conditions that become harder to maintain as class size grows.

5.4 Influence of Large Class Size on Teacher Support

The finding that teachers do not provide optimum support to students in large Chemistry classes aligns with Rubin (2012), who found that teachers in large classes are unable to spend sufficient time with individual students to confirm understanding, and with Halbech, Ehrle, Zahorik, and Molnar (2011), who found that large classes reduce in-depth content coverage due to time lost managing student behaviour.

5.5 Synthesis Across Research Questions

Read together, the four research questions point to a consistent underlying pattern: large class size in Chemistry does not primarily undermine teachers' technical delivery of content — the cluster mean for teaching itself (2.33) fell in the disagreed range — but instead erodes the conditions that make delivered content land with individual students: sustained interaction, individualised support, and an environment conducive to sustained attention. This distinction matters for how the findings should be interpreted and acted upon. It suggests that interventions narrowly focused on teacher training in content delivery are unlikely, on their own, to resolve the difficulties large classes create; more promising are interventions that address the structural conditions of the classroom itself — smaller effective teaching groups, additional support staff, or differentiated tools that allow one teacher to extend individualised attention across more students than would otherwise be possible.

This pattern also situates the present findings within the broader empirical disagreement discussed in the literature review. Where Mahlo (2015) found no significant relationship between class size and achievement in a South African boarding-school context, and Barcca and Fredua (2008) characterised the wider evidence base as inconclusive, the present study's Chemistry-specific findings suggest that the relationship may be more consistently negative in subjects — like Chemistry — that depend heavily on individualized teacher guidance during abstract reasoning and practical demonstration, and in under-resourced public school contexts where large class size compounds existing infrastructural strain rather than substituting for it.

6. CONCLUSION

Based on the findings, the study concludes that large class size negatively influences the learning of Chemistry, classroom interaction during Chemistry lessons, and the level of support teachers are able to provide students — while its influence on teaching practice itself is more mixed. Taken together, the findings indicate that large class size is a substantive barrier to effective Chemistry instruction in the study area, operating primarily through its effects on student engagement, comprehension, and the individualized support teachers can realistically provide.

6.1 Educational Implications

These findings carry implications for classroom teachers, parents, government, and students:

• Teachers should adopt intentional strategies for managing large classes, including structured grouping and varied instructional techniques suited to Chemistry's abstract and practical demands.

• Parents should provide necessary learning materials and advocate with school management for class-size adjustments where enrolment is disproportionate to available teaching capacity.

• Government should invest in additional classroom infrastructure, recruit sufficient specialist Chemistry teachers, and provide instructional materials suited to large-class contexts.

• Students should be encouraged to set attainable academic goals and dedicate additional study time, recognising that class size alone does not determine individual academic outcomes.

6.2 Recommendations

• Policymakers and government should ensure additional classroom construction and enforce a maximum class size of 40 students, consistent with the FRN (2013) benchmark.

• Parent-Teacher Associations, School-Based Management Boards, and philanthropic or charitable organisations should complement government efforts to expand classroom infrastructure.

• Teachers should employ a variety of teaching methods that remain effective across differing class sizes, rather than relying solely on lecture-based delivery.

6.3 Limitations of the Study

The study was limited to a single local government area within one education zone; this geographic scope should be considered when generalising the findings, and care should be taken before extending conclusions beyond comparable contexts.

6.4 Suggestions for Further Study

• Replication of this study in other states and local government areas would help establish the generalisability of these findings.

• Replication across a wider geographical area encompassing both private and public schools would clarify whether school type moderates the observed relationships.

6.5 Contribution of the Study

This study contributes context-specific empirical evidence on a widely debated relationship in education research. While the influence of class size on academic outcomes has been studied extensively in the international literature, with mixed and sometimes contradictory findings depending on context (compare, for instance, the present study's findings with Mahlo's 2015 South African results), relatively few studies have isolated Chemistry specifically — a subject with distinct instructional demands around abstract reasoning and practical demonstration — within Nigerian public secondary schools. By disaggregating the analysis across teaching, learning, classroom interaction, and teacher support as four distinct dimensions, rather than treating 'effective teaching and learning' as a single composite outcome, this study also offers a more granular picture of where, specifically, large class size exerts its strongest effects — primarily on learning and teacher support, rather than on teaching delivery in isolation. This distinction offers a more precise basis for policy and instructional intervention than a single aggregate finding would.

Acknowledgements

The researchers acknowledge the Post Primary Schools Service Commission, Onitsha Education Zone, for population data, the participating public secondary schools and their Chemistry teachers and students in Onitsha North Local Government Area for their cooperation, and the validating experts at Nwafor Orizu College of Education, Nsugbe, for their contribution to instrument validation.

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