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Classroom Noise Pollution and Its Impact on Students' Behavioral Engagement in Secondary Schools in Ojo Local Government Area, Lagos State, Nigeria

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ABSTRACT
This cross-sectional study assessed measured classroom noise and students' self-reported behavioral engagement in secondary schools in Ojo Local Government Area, Lagos State. Six schools were purposively selected by ownership and proximity to the main road. Noise was measured in 30 classrooms (five per school) with a SMART SENSOR AS844+ sound level meter in three sessions (background, morning and afternoon) over five school days, and a questionnaire was administered to 900 students (150 per school). Data were analyzed using descriptive statistics, one-way ANOVA and chi-square tests. Mean background levels ranged from 34.3 to 46.5 dB(A), and five of the six schools exceeded the 35 dB(A) WHO/ANSI limit for unoccupied classrooms. Mean occupied-classroom levels ranged from 64.9 to 77.8 dB(A) in the morning and from 70.7 to 84.2 dB(A) in the afternoon, above the 55 dB(A) reference value at every school. Among students, 61.5% reported that classroom noise occurred often or very often, 62.7% found it difficult to concentrate when the classroom was noisy, and 58.9% reported that teacher explanation was the lesson phase most disrupted. Chi-square tests showed no significant school differences in response distributions, although ANOVA indicated differences for some items. Measured acoustic conditions and students' perceptions were not statistically linked, so the findings are descriptive and do not establish that noise caused reduced engagement. Reducing student-generated noise and improving classroom acoustics merit testing in longitudinal or multilevel studies.

Keywords:
Noise Pollution,
Behavioral Engagement,
Secondary Schools,
Classroom Acoustics and
Lagos State

INTRODUCTION

Education is widely acknowledged as a cornerstone for social and economic development, and the classroom environment plays a crucial role in shaping the learning experiences of students. Among numerous factors influencing academic performance and students' engagement, environmental conditions have emerged as significant determinants (Owoseni et al, 2020). One of the most pressing environmental issues affecting schools globally is noise pollution which refers to any unwanted or disruptive sound that interferes with daily activities such as communication, concentration, and most importantly learning (WHO, 2018, Anikwe et al., 2025)). While noise has long been recognized as a general public health concern, its effect within the educational sector has gained increasing attention among researchers, policymakers, and educators (Shield & Dockrell, 2003).

According to Berglund & Lindvall 1995, Classroom noise can originate from both external and internal sources. External sources include traffic, commercial activities, and construction work, while internal sources includes classroom interactions, overcrowding, poor building design, and inadequate noise control measures.

Globally, several studies have demonstrated that excessive classroom noise can hinder students' active participation in classroom activities and

behavioral engagement. According to the world health organization, WHO (2011), the permissible noise level in school environment should not exceed 35 decibels (dB). However, recent studies indicate that noise levels in schools worldwide frequently exceed the recommended threshold of 35decibels (dB). Background criteria for unoccupied classrooms, such as the 35 dB(A) limit in ANSI/ASA S12.60-2010 (ANSI/ASA, 2010), differ from the sound levels typically recorded in occupied classrooms during lessons, and the two are therefore reported separately in this study.

Okedeyi et al., (2023), reported average noise levels exceeding 70 decibels (dB) in primary schools within the Ikorodu Division Area of Lagos State. This is far above the recommended threshold of 35dB. Also, Atilade et al., (2024) with Okedeyi as co-author looked at some secondary schools in the Ikorodu division area of Lagos state and also recorded noise levels of different schools to be far above the WHO threshold of 35 dB These findings shows how noise exposure levels is in the Ikorodu division area of Lagos state and sets the stage for looking into similar issues in the Ojo division of Lagos.

In Lagos state, Nigeria's most populous and urbanized region, noise pollution is an everyday reality (Kareem & Olatunji 2021). The situation is particularly severe in educational institutions situated near markets, highways, and densely populated residential areas. The Ojo division which combines both urban and semi- urban features, presents a unique case where schools are exposed to multiple noise sources. Yet, there is limited empirical evidence on how such noise levels influences students' classroom behavioral engagement in the region. Several studies on noise pollution in Nigeria have focused on environmental and health issues (Oyedepo, 2012). This leaves a gap in understanding its major impact on students' classroom behavioral engagement.

This study seeks to fill the identified gaps by measuring classroom noise levels in secondary schools within Ojo and also examining how students report that noise affects their' behavioral engagement. The results of this study will provide profound insight for Educators, school administrators, policy makers, and major stakeholders in designing effective policies to promote conducive learning environment. Ojo LGA lies along the Lagos-Badagry Expressway and combines urban and semi-urban settings with federal, state and private schools exposed to different traffic, market and residential noise sources, which makes it a useful setting for examining how school context relates to classroom noise. The study addressed three research questions: (1) What are the background and occupied-classroom noise levels in the selected schools, and how do they compare with WHO/ANSI reference values? (2) How do students report that classroom noise affects their concentration and engagement in lessons? (3) Do these reports differ between schools?

MATERIALS AND METHOD

Study Area and School Selection

The study was conducted in Ojo Local Government Area (LGA), located at the western end of Lagos State, Nigeria, along the Lagos-Badagry expressway. The LGA hosts a mix of federal, state, and private secondary schools situated in diverse environmental settings with proximity to bus stops and marketplaces held as one of the major criteria for selection. These environmental settings, makes it suitable for comparing noise exposures across diverse school contexts. Based on all these criteria, six secondary schools were purposively selected.

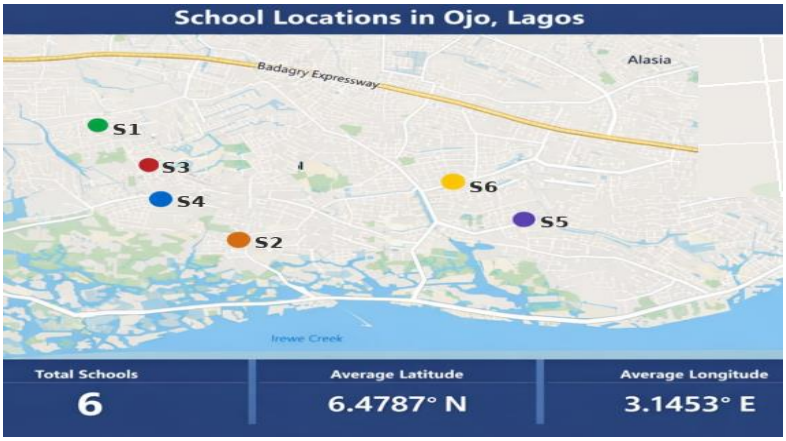


Figure 1: Map of Ojo Local Government Area showing the Locations of the Six Selected Schools.

Table 1. Characteristics of the six secondary schools sampled in Ojo LGA.

Code	Ownership	Location within Ojo LGA	Key Environmental Features
S1	State	Otto	Dense residential area; narrow roads; close to main road
S2	State	Ijanikin	Innermost Ijanikin; moderate distance from main road
S3	State	Ajangbadi	Mixed residential-commercial area; close to major road
S4	Federal	Ijanikin	Along Lagos-Badagry Expressway; moderate distance from road
S5	State	Ajangbadi (Estate)	Innermost estate location; moderate acoustic environment
S6	State (Model)	University campus	Within university campus; relatively quieter surroundings

Noise Measurement Procedure

The noise level measurement in this study is the SMART SENSOR AS844+ Sound Level Meter. The device was calibrated within the time approved by manufacturer with a measuring sound levels range of 30dB to 130dB. Also, it has a high precision accuracy of approximately 1.5 dB with a resolution of 0.1dB with a frequency detection range of the AS844+ sound level meter ranges from 31.5 Hz to 81 KHz making it suitable for detecting a wide spectrum of environmental sound. This study adopted a systematic method of noise measurement that helps maintain a level of consistency across selected schools. Measurements were taken in five classrooms per school, which brings the total number of assessed classrooms to 30 over 5 consecutive school days. The measurement were taken at three sessions per day. The equivalent continuous A-weighted sound level (LAeq) (dB(A)) recorded over the 1-h measurement period was used as the representative noise level for each classroom. Noise levels were measured using a calibrated sound level meter set to A-weighting and expressed in dB(A). Measurements were taken for 1 hour in each sampled classroom during normal teaching activities. The microphone was positioned at approximately 1.2 m above the floor and away from walls and other reflective surfaces. The conditions of the doors and windows were recorded during each measurement and are presented in Table 2. The first session was the background which starts from 06:30-07:00 am. The background session aided in quantifying noise level of unoccupied classrooms. The second session was the morning session which spans from 08:00-10:00 am. The morning session gave an in-depth look into noise levels of occupied classroom. While the third session was the afternoon session which spans from 12:00-2:00 pm. The afternoon session helps in understanding the reality of classroom noise levels during and after break sessions.

Noise Analytical Model: Equivalent Continuous Sound Level

The equivalent continuous sound (Leq), is the particular sound level that carries the same acoustic energy as the fluctuating sound recorded over period (Guarnaccia, 2020).

The Equivalent Continuous Sound Level is mathematically expressed as in Equation (1):

$$L_{eq} = 10\log_{10}\left(\frac{1}{T}\int_0^T \frac{P^2A(t)}{P_0^2}dt\right) \quad (1)$$

Where: Leq = Equivalent continuous sound level (dB)

T = Total measurement time interval (seconds)

$P^2A(t)$ = Instantaneous A-weighted sound pressure at time t (Pa)

p_0 = Reference sound pressure (20 μPa, the threshold of human hearing)

For discrete measurements such as those collected in this study, the equation (1) is approximated to a new form as seen in Equation (2):

$$L_{eq} = 10\log_{10}\left(\frac{1}{n}\sum_{i=1}^{n}10^{Li/10}\right) \quad (2)$$

Where:
n = Number of measurements taken
L_i = Sound level of the i-th measurement (dB)

Questionnaire Survey

To fully understand students' perception of noise, a structured questionnaire was administered to students of selected schools sampled for this research. The questionnaire was designed based on previous approaches adopted by previous studies to examine noise levels in educational researches (Fields, 1993; Berglund et al., 1995). The design of the particular questionnaire used in this study was inspired by previous studies that examined the relationship between classroom acoustic conditions and students' behavioral outcomes (Shield & Dockrell, 2003; Stansfeld & Matheson, 2003). The questionnaire assessed classroom noise exposure, concentration, refocusing, lesson disruption, and perceived academic performance. Items were rated using structured Likert-type response scales. Content validity was established through expert review, and the instrument was pilot-tested among students outside the study sample. The questionnaire demonstrated acceptable internal consistency, with a Cronbach's alpha of 0.82.

Statistical Analysis

Responses gathered from the questionnaire administration were analyzed using frequency distributions and percentages. Also, one-way analysis of variance (ANOVA) was used to test for significant differences between schools on key responses categories. Chi-square tests were also used to assess whether the overall distribution of the responses differed across selected schools. Because Likert-type responses are ordinal, the ANOVA results are treated as exploratory and are interpreted alongside the chi-square tests of the full response distributions. Students were nested within selected classrooms and schools. Results are reported as test statistic, degrees of freedom and p-value in Table 4

RESULTS

Classroom Noise Level and Meteorological Measurements

Table 2 shows the mean acoustic and environmental parameters for each school. Background (unoccupied) noise levels ranged from 34.3 dB(A) at School S4, to 46.5 dB(A) at School S3; five (5) of the six (6) schools exceeded the WHO/ANSI unoccupied limit of 35 dB(A), with only S4 at Ijanikin, falling within both the lower and upper WHO background thresholds. The occupied classroom levels were substantially higher and exceeded the WHO occupied-classroom threshold of 55 dB(A) at every school, in both morning and afternoon sessions, without exception (Figure 2). The noise level at afternoon exceeded the morning levels at five of the six schools, most markedly at School S1 (77.8 to 84.2 dB[A]), the highest value recorded in the study) and School S3 (71.9 to 80.9 dB[A]); School S2 was the sole exception, with a higher morning (77.5 dB(A)) than afternoon (72.8 dB(A)) reading. Mean classroom air temperature ranged from 26.7°C to 29.3°C across schools (overall mean 28.1°C), exceeding the ASHRAE Standard 55 upper comfort threshold of 26°C at every school (Figure 3). The mean relative humidity ranged from 69.1% to 81.7% (overall mean 76.6%), exceeding the WHO upper comfort threshold of 60% at every school, in some cases by more than 20 percentage points (Figure 4). Classroom-level Leq measurements showed substantial variation across schools, with background levels ranging from 34.3 to 46.5 dB(A), morning levels from 64.9 to 77.8 dB(A), and afternoon levels from 70.7 to 84.2 dB(A).

Student Perceptions of Classroom Noise and Its Academic Impact

Table 3 shows the demographic profile of students that responded to the questionnaire. The questionnaire had nine sections and 900 respondents (150 students from each school). Tables 4a and 4b show the distribution of student responses to single-response items on classroom noise, concentration, and Academic Impact. Figure 5 shows that more than three in five students across the six schools (61.5%) reported that classroom noise occurred often or very often, and a close proportion (62.7%) found it difficult to concentrate when the classroom was noisy. Both items varied significantly by school ($p = .047$ and $p < .001$, respectively). Teacher explanation stood out as the lesson phase most affected, cited by 58.9% of students, and this also differed significantly between schools ($p < .001$). Recovery after a noise episode was slow: only about one in five students (20.9%) said they could refocus immediately, and this too varied significantly across schools ($p = .009$). The

academic cost, however, held steady regardless of a school's noise profile. 81.1% of students said they had to repeat or re read their work, and the same share perceived that their performance had suffered, with neither item differing significantly between schools. Students' overall sense of how much noise affected them (64.7% reporting "very much" or "a lot") did vary significantly by school ($p = .028$). The pattern suggests that while how much noise bothers students depends on their school's acoustic environment, its academic toll, lost concentration turning into repeated work and a sense of underperformance, was reported by students in all six schools.

Table 2: Mean acoustic and environmental parameters by school, with WHO/ANSI and ASHRAE reference values.

School	Background Leq dB(A)	Morning Leq dB(A)	Afternoon Leq dB(A)	Temp (°C)	RH (%)
S1	38.9	77.8	84.2	29.1	77.4
S2	38.1	77.5	72.8	29.3	76.1
S3	46.5	71.9	80.9	27.2	74.5
S4	34.3	69.5	72.6	26.9	81.7
S5	36.2	66.6	70.7	26.7	80.7
S6	45.7	64.9	71.6	29.3	69.1
Overall mean	39.95	71.4	75.5	28.1	76.6
WHO / ANSI reference	≤ 35 (lower) / ≤ 40 (upper)	≤ 55	≤ 55	23–26 (ASHRAE)	≤ 60 (WHO)

Table 3. The demographic profile of student respondents (N = 900)

Characteristic	Category	n	%
Age (years)	10–12	180	20.0
	13–15	450	50.0
	16–18	270	30.0
Gender	Male	380	42.2
	Female	520	57.8
Class level	Junior Secondary (JSS)	382	38.3
	Senior Secondary (SS)	518	61.7
Total		900	100.0

Table 4a: Distribution of Student Responses to Single-Response Items on Classroom Noise, Concentration, and Academic Impact (Q1, Q2, Q5–Q9)

Item	Key Response Category	Combined % (Range Across Schools)	Test Statistic
Q1 – Frequency of classroom noise	Often / Very often	61.5 (51.3–70.0)	ANOVA $F = 2.253$, $p = .047$*; $\chi^2 = 17.118$, $df = 15$, $p = .312$ (ns)
Q2 – Difficulty concentrating when noisy	Difficult / Very difficult	62.7 (53.3–70.0)	ANOVA $F = 4.283$, $p < .001$***; $\chi^2 = 14.977$, $df = 15$, $p = .453$ (ns)
Q5 – Repeating / re-reading work	Yes + Sometimes	81.1	ANOVA $F = 1.594$, $p = .159$ (ns); $\chi^2 = 10.179$, $df = 15$, $p = .808$ (ns)
Q6 – Perceived poor performance	Yes + Sometimes	81.1	ANOVA $F = 1.572$, $p = .165$ (ns); $\chi^2 = 10.253$, $df = 15$, $p = .419$ (ns)
Q7 – Speed of refocusing after noise	Immediately	20.9 (16.7–25.3)	ANOVA $F = 3.068$, $p = .009$**; $\chi^2 = 5.601$, $df = 15$, $p = .986$ (ns)
Q8 – Lesson phase most disrupted	Teacher explanation	58.9 (53.3–63.3)	ANOVA $F = 4.999$, $p < .001$***; $\chi^2 = 4.628$, $df = 15$, $p = .995$ (ns)
Q9 – Overall perceived impact of noise	Very much + A lot	64.7 (56.7–70.0)	ANOVA $F = 2.522$, $p = .028$*; $\chi^2 = 10.726$, $df = 15$, $p = .772$ (ns)

Table 4b: Multiple – response questionnaire items (Q3, Q4)

Response Category	% of Students Selecting This Category
Q3 – Mechanisms of disruption	
Distracted by peers	76.1
Cannot hear teacher clearly	66.2
Loss of concentration	64.2
Irritation / stress	54.4
Forgetting the task in progress	45.7
Q4 – Sources of noise	
Student talking	84.2
Corridor noise	46.1
Adjacent classrooms	37.2
Playground noise	30.8
Traffic / external noise	23.9

3.3 Acoustic and Thermal-Environmental Conditions

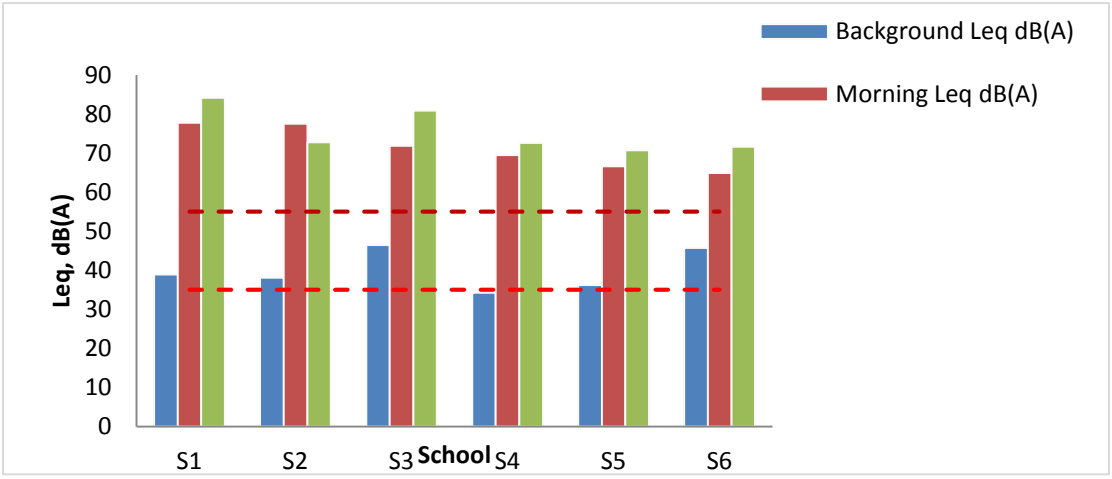


Figure 2. Mean classroom Leq dB(A) by school and session (background, morning, afternoon), with WHO/ANSI and world-average reference lines.

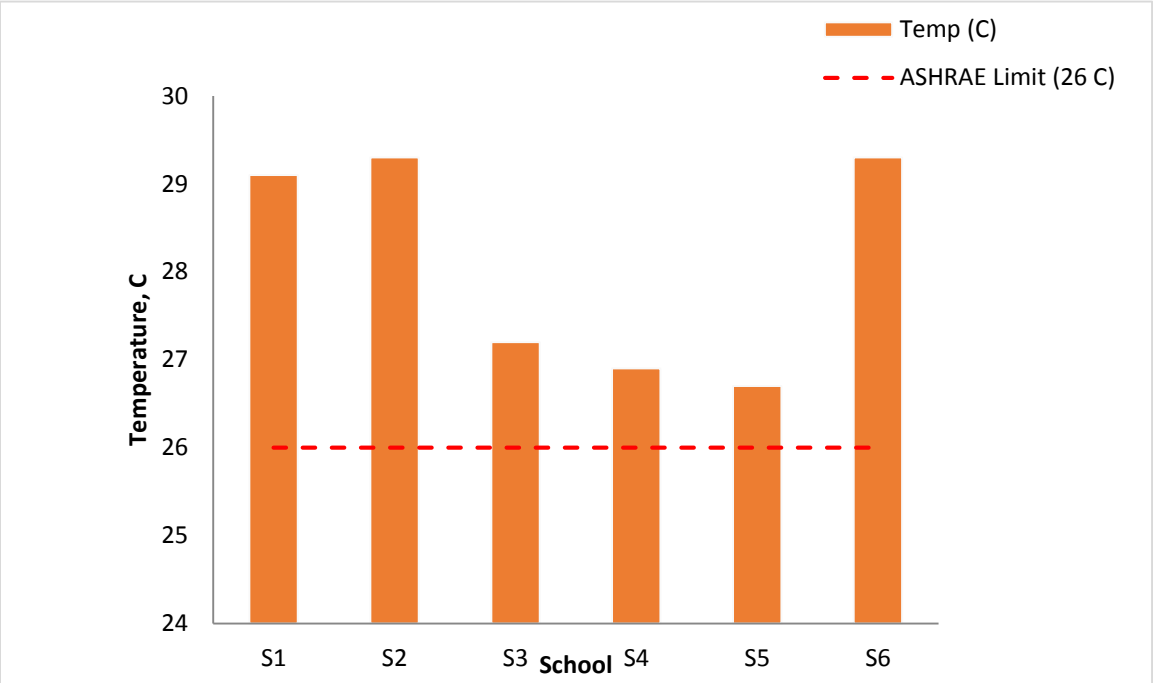


Figure 3. Mean classroom air temperature (°C) by school, with ASHRAE thermal-comfort reference lines.

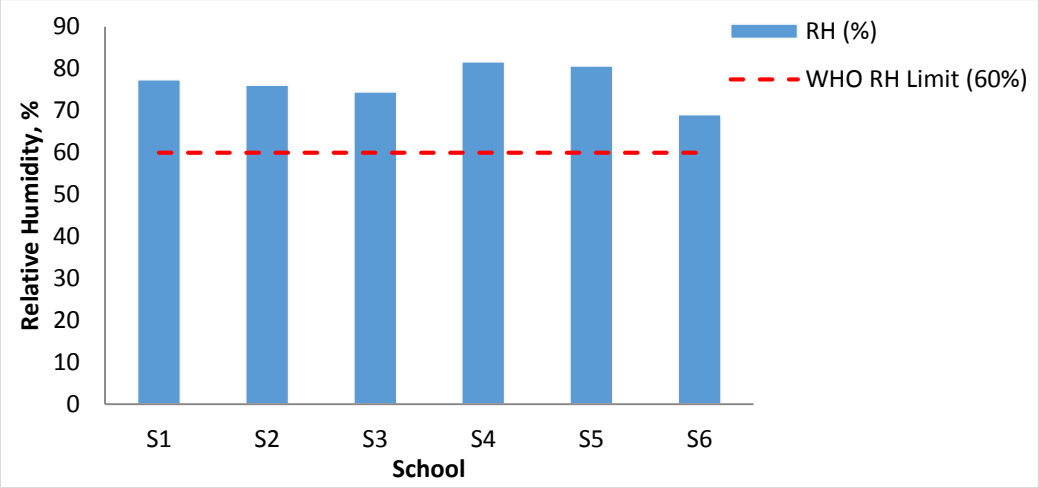


Figure 4: Mean relative humidity (%) by school, with WHO comfort reference lines.

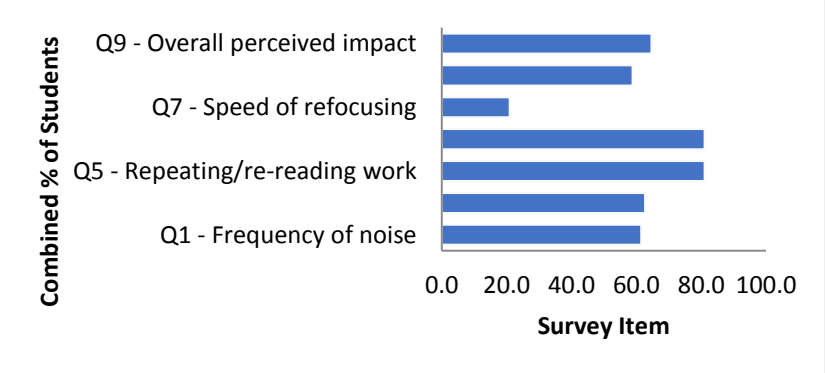


Figure 5: Student Survey Responses: Combined % by Item (Range Across Schools)

DISCUSSION

This study examined whether classroom noise levels in secondary schools in Ojo LGA exceed recommended standards and how students reported that it affected their engagement in class. The findings showed that noise levels were consistently high across all the schools studied. In fact, all the sampled schools recorded noise levels above the WHO recommended level for occupied classrooms (Morning and Afternoon sessions) during all the measurement sessions. The highest recorded noise level in the afternoon at one of the sampled schools was found to be 84.2 dB(A). The result was higher than the average classroom noise level reported by Shield and Dockrell (2003), suggesting that students in the study area are exposed to unusually high levels of classroom noise. Such comparisons should be made with caution because weighting, measurement duration and classroom activity differ between studies. The finding is also similar to previous studies carried out in other parts of Lagos State. For example, Okedeyi et al. (2023) and Atilade et al. (2024) reported high noise levels in primary and secondary schools in the Ikorodu division. The present finding therefore suggests that excessive classroom noise may be a wider problem in Lagos State and is not limited to schools in a particular location.

One important finding from the study was that students' talking was the source of classroom noise most frequently reported by students (84.2%), although this does not establish it as the dominant source acoustically. External sources such as traffic and structural noise were present, but they were reported less often as sources of the noise experienced during lessons. This is important because student-generated noise can be addressed to some extent through effective classroom management. It also agrees with the irrelevant-speech effect described by Baddeley (1992), which explains that speech from other people can interfere with tasks that require attention and verbal working memory. The teacher-explanation stage of the lesson appeared to be particularly affected by noise. This agrees with Shield and Dockrell (2008), who noted that students' understanding of spoken instruction can be affected by background noise. When students are unable to hear the teacher clearly, the effect may go beyond the explanation itself and affect activities such as note-taking, classwork and preparation for assessment. This is consistent with the responses from the students in this study, many of whom indicated that they had to re-read their work and believed that noise affected their academic performance. These responses reflect students' perceptions and do not demonstrate lower academic attainment.

Another finding that deserves attention is the difficulty experienced by students in regaining concentration after a noisy episode. Only about one-fifth of the students indicated that they were able to regain their focus immediately after the noise stopped. This suggests that the effect of classroom noise may continue even after the noise itself has ended. Leroy (2009) described a similar idea through the concept of attention residue, where part of a person's attention remains connected to a previous task after an interruption. In a normal classroom lesson, where several interruptions may occur, the actual effect of noise may therefore be greater than the amount of time for which the noise was produced. Repeated interruptions can reduce the time students have available for effective learning and may make it difficult for them to maintain concentration throughout the lesson.

Several limitations should be noted. The study was cross-sectional, so it cannot show that classroom noise caused the reported difficulties. Schools were purposively selected and only six schools and 30 classrooms were measured, which limits generalization and introduces possible sampling bias. Students' reports were self-reported and collected with a single instrument, so common-method bias is possible. Students were nested within classrooms and schools, and this clustering was not modeled. Confounding by factors such as class size, building design, teaching style, temperature and humidity was not controlled. Noise measurements and questionnaire responses were not statistically linked at the classroom level.

CONCLUSION

The findings of this study show that classroom noise is a significant environmental problem in the six secondary schools studied in Ojo LGA, Lagos State. Measured noise levels were above the WHO/ANSI reference values in occupied classrooms at every school and in unoccupied classrooms at five of the six schools. The results also showed that classroom temperature and relative humidity were generally above the recommended comfort levels, indicating that students were exposed to more than one form of environmental discomfort during learning. The questionnaire responses are consistent with the measured conditions, although the two datasets were not statistically linked. Many of the students reported that noise made it difficult for them to concentrate, hear the teacher clearly and remain focused during lessons. The teacher-explanation period was identified as the part of the lesson most affected by noise. Students also reported having to repeat or re-read their work and experiencing poorer performance in class activities or tests

because of noise. These findings suggest that classroom noise may go beyond temporary distraction and interfere with students' normal learning activities. Causation cannot be inferred from this cross-sectional design.

Student talking was the source of classroom noise most frequently reported by students across the schools. This is an important finding because it suggests that reducing classroom noise may not depend only on changes to the physical structure of the classrooms. Effective classroom management, appropriate student conduct, and teacher awareness of noise levels may also be necessary. At the same time, physical measures such as the use of sound-absorbing materials and better window and classroom designs may help reduce noise from both internal and external sources. Future studies could involve a larger number of schools and a longer measurement period to provide a broader picture of classroom noise levels. Direct classroom observations and interviews with teachers could also provide more information about the sources of noise and how teachers and students respond to them. It would also be useful to combine measured noise levels with students' actual academic-performance records. Further studies could examine the combined influence of noise, temperature, humidity and overcrowding on students' classroom behavior and learning. Such studies may provide useful evidence for developing classroom environmental and acoustic guidelines that are appropriate for schools in Nigeria.

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