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Indoor Noise in Academic Libraries: A Case Study of University of Ilorin Main Library, Nigeria

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Abstract

This study assessed indoor noise at the University of Ilorin Main Library in Nigeria, using semi-structured questionnaire and sound level meter. Sources, subjective rating, extent of noise disruption, and ambient daytime and night-time noise levels in the library were determined. The study revealed that noise rating and extent of disruptions were divergent. Daytime sound pressure level in the library is equally location dependent, fluctuates, and most of the measurements surpass the recommended maximum limit of 45 Decibels. It is suggested that a noise policy should be formulated for the library, in addition to acoustic upgrading and library space reclassification.

Keywords: Library, Noise, Ilorin, Empirical Assessment, Subjective Assessment

Introduction

Certain indoor environments such as libraries require quietness and cannot tolerate any form of noise at any time of the day. This is because absolute silence is required for comprehension, skill development and proofreading. Though libraries are custodians of book and non-book materials, modern libraries play more important roles as work, study and meeting spaces, and cheap public access points to Internet and multimedia services (Markham, 2004). Hence, libraries now experience more patronage than ever before, and more physical facilities are often provided to cope with the needs of library users. Environmental factors such as ventilation, noise and physical facilities are variables that are likely to influence the use of a library (Saka *et al*., 2012). Noise, in particular, has a high tendency to discourage library use; in a learning environment, too little background noise can make the slightest sound noticeable thereby enhancing distraction, while too much noise leads to low concentration and annoyance (Hodgson and Moreno, 2008).

Established acceptable noise level in libraries range between 35–45 decibels (Kiely, 1997; Duggal, 2007; Davis and Cornwell, 2009), and library noise could also be evaluated based on perception of library users. Some research outcomes conclude that cognitive task performance such as students' concentration and librarian's consultation is hindered by background noise (Kjellberg et al., 1997; Sullivan, 2010). Findings of the research by Gordon-Hickey and Lemley (2012) indicate that the influence of background noise on cognitive activities has physiological rather than psychological origins.

Therefore, students accurately self-assess their acoustic study environment needs while it is recommended that academic libraries should offer multiple acoustic study environments for college students. Invariably, incorporation of objective acoustical standards should be an important principle when embarking on library design projects (Salter, 2002).

Recently, some authors used subjective and/ or empirical means to assess noise levels in libraries. Ntui (2009) found that the levels of noise in the University of Calabar Library, Nigeria was between 43.5 and 88.5 dB (A). The high noise level was attributed to conversation of people, automobiles, aircrafts, cellular phones, and in some equipment in the library. A student satisfaction survey (Elliot, 2012), conducted at Bamford Library in Harper Adams University College U.S.A. , indicated that most students prefer working in a quiet place, few prefer a place with small amount of distractions, while minority choose to work with friends. In all, 358 respondents were satisfied with the noise level in the library, 40 students wanted a quieter library, while 34 respondents would like stricter enforcement of existing rules. Balanli *et al*. (2007) reported that in addition to difficulties in accessing resources, poor lighting quality and visual pollution, 20.50 per cent and 8.30 per cent of library users at the Yildiz Technical University Library, Istanbul, Turkey complained about high indoor and outdoor noise respectively. A similar study at Kwame Nkrumah University of Science and Technology Library, Ghana (Senyah and Lamptey, 2011) examined susceptibility of the library to outdoor noise pollution. Majority of respondents (94 %) indicated that the most disturbing noise emanates from Royal Parade Grounds; 88.1% observed high noise infiltrating from the Great Hall; 71.4% observed noise from the Halls of Residence as a source of worry while 48.8%, 23.8% and 9.5%, are concerned about noise from vehicles, library users, and staff respectively.

Invariably, noise rating is based on location and perception of the library user. Nevertheless, every library user has the responsibility to respect the rights of other library users by ensuring that there is less noise while using the library. Conducive environment for all library clientele to study is a cardinal policy of libraries. While trying to guarantee high level of quietness in the library, users often exhibit some acts of disturbances or behaviours which are inimical to the noise policy of the library. Examples of inappropriate and unacceptable behaviours that create discomfort for library users include loud conversation, use of audio players, rowdiness, and noisy group study. The scale of discomfort which is socio-demographic or physiologic is not, however, uniformly experienced by library users across libraries. Because of differing acoustic, operational level and outdoor environment of libraries, individual library noise assessment would give a better understanding of specific acoustic needs, noise sources, noise control measures, and policy formulation. In the light of the above, the paper investigates the sources of noise, its subjective rating and effects, and the ambient noise level at University of Ilorin library.

Study Area

The University of Ilorin Library is a second generation academic library established in 1976 with its parent body, the University of Ilorin. It was commissioned for use in March, 1990 with a capacity for about 2,000 users when fully utilized. The library has a collection of about 450,000 volumes of books, excluding pamphlets, journals, theses/dissertations and documents (archives). Like its parent institution, the library is a hybrid conventional system and its collections are developed along departmental, faculty and course consideration. The library is also stocked with audio-visual materials and databases that can be accessed on CD-ROM and the internet. The library offers a wide range of services to its clientele which include borrowing of books, inter-library loan, book reservation, photocopy, and 24-hour opening service during semester examinations. There are also facilities for private and group reading and discussions. At present, the library serves staff and students from thirteen (13) faculties.

The library is a magnificent one-storey building with a basement. The library basement contains the bindery unit, photocopy stand, reading space for 300 readers, and books in science, agriculture, pharmacy and library science. The ground floor consists of two wings. The left wing houses books in engineering and technology and can accommodate 400 readers. The right wing contains reference books, document materials and newspaper reading section. The ground floor serves as the entry and exit point to the library,

and also contains the cloak room, photocopy stand, technical services division, and the circulation and reference sections where various consultations and loan transactions take place. The first floor contains the University Librarian's office, serials section, audio-visual facility, reading section with 250 seating capacity, and books in arts, social and management sciences, and education. The library is normally very active between 8am and 6pm, especially during examination periods.

Research Method

The method employed in this study to assess interior noise at the University of Ilorin Library is by questionnaire survey (subjective assessment) and physical measurement (empirical assessment). Both assessments were carried out between May, 2013, which was the peak of academic activities and August, 2013 when students were on break.

Subjective Assessment

A structured questionnaire was designed and administered by the researchers on randomly selected library users to elicit information on noise at the University of Ilorin library. The solicited information included background information of respondents, subjective noise rating, source(s) of noise, and extent of noise disturbance. The number of undergraduate and postgraduate students (population size) during the 2012/2013 academic session was 30,742 (University of Ilorin, 2013). The sample size for a known population size is given as (Krejcie and Morgan, 1970; Kothari, 2004):

$$n = \frac{z^2 p(1-p)N}{e^2(N-1)+z^2 p(1-p)}$$

Where
n is the sample size;
z = standard variate at a given confidence level;
P = sample proportion;
e = margin of error;
N = population size.

For *N*= 30,742, at 95 % confidence level (z = 1.96) and 4% margin of error (e = 0.04), 50% baseline level of indicators (P= 0.5), the sample size (*n*) from equation (1) is 588 respondents. Assuming the return rate for duly filled questionnaires is 95%, a minimum of 618 questionnaires is appropriate for the survey.

A total of seven hundred (700) copies of the questionnaire designed for the study were produced and administered on a one-to-one basis. This approach is known to have high return rate since the questionnaire is usually delivered directly to the respondents and collected immediately after completion. Out of the 700 copies of the administered questionnaire, 692 were retrieved from respondents, representing approximately 99% reclamation, out of which 679 (97%) were fully completed and usable for analysis. The 13 unusable responses contained unanswered questions or multiple answers.

Empirical Assessment

Noise can be appropriately measured in decibels (dB(A)) units using a sound level meter because it closely replicate the loudness perceived by the human ear ((Kiely, 1997).The equipment used in this study to measure noise level is the digital datalogging sound level meter, model HD600 manufactured by Extech® Instruments Corporation, U.S.A. The equipment meets Type 2 requirements of ANSI S1.4 and IEC 61672-1, and measures and displays Sound Pressure Level (SPL) from 30dB to 130dB (±1.4dB accuracy) in 3 measurement ranges. Noise measurements were taken following the prescribed procedure stipulated in HD600 User's Guide. The equipment was set to measure A-weighted sound levels at a sampling interval of 59s for 10 hours (8.00am to 6pm). Measurements were replicated thrice at several locations within each floor for one week. The sound level meter was positioned at a height of 1.5m above the ground and at least 1.5m away from reflecting surfaces. Noise descriptors used in this study are:

a) Maximum noise level (L_{max}); Minimum noise level (L_{min}); Average noise level (L_p)

$$L_p = 20\log\frac{1}{n}\sum_{j=1}^{n}10^{\left(\frac{L_j}{20}\right)}$$

Where

n = number of SPL taken;

L_j = j^{th} SPL; j = 1, 2, 3, …., n

b) Equivalent Sound Pressure Level (L_{eq}); is a constant noise level that, over a given time, expends the same amount of energy as the varying sound level over the same period of time.

Mathematically, $L_{eq} = 10\log \sum_{i=1}^{i=n} \left(10^{\frac{L_i}{10}}\right)(t_i)$

Where

n = total number of SPL samples taken

L_i = SPL in the *i*th sample

t_i = fraction of total SPL sample time

Noise pollution level (L_{NP})

$$L_{NP} = L_{eq} + K\sigma$$

Where

L_{eq} = Equivalent Sound Pressure Level;

K = 2.56 (Kiely, 1997);

ó = Standard deviation.

Results and Discussion

The demographic characteristic of respondents is presented in table 1. Most of the respondents were within 17–27 age group, and majority of them were undergraduates. Male and female represented 52% and 48% of the total respondents respectively. The answer provided by respondents on identified major source of noise in the library is presented in table 2.

Table 1: Background Information of Respondents

Age(years)	No. of respondents	%	Gender	No. of respondents	%	Level of student	No. of respondents	%
17-27	630	93	Male	355	52	100	153	23
28-37	43	6	Female	324	48	200	114	17
38 and above	6	1				300	153	23
						400	194	29
						500	44	6
						Postgraduate	21	3
Total	**679**			**679**			**679**	

Students were identified as the major source of noise in the library (41%) followed by equipment (25%) such as photocopiers, scanners, outdoor lawn mower, air conditioner, and ceiling fan. The use of cell phones in the library and loud conversation by library staff was also considered as a source of noise to 17% and 15% of library users respectively. Other identified sources of noise by 1% of respondents include footsteps, radio, personal stereo, trolley wheels, furniture (shoving) and doors (opening and closing). Perhaps the main reason why noise is prevalent among students is because University of Ilorin Library does not have any written policy or mechanism to control/prevent noise within the library. Library staff and students make or receive calls and listen to radio or music within the library because there is no special area designated for such activities. Also the circulation desk and reception are located between reading spaces in the ground floor, hence normal conversation by library staff members and students is unrestricted. Furthermore, disruptions are bound to arise from some equipment and the existing acoustic configuration which lacks noise absorbers.

Table 2: Sources of Noise in the library

Sources of noise	No.	(%)
Students	278	41
Equipment	173	25
Cell phones	118	17
Staffs	102	15
Others	8	1
Total	**679**	**100**

The subjective rating of library indoor environment and the extent of reading/learning disruption by noise are shown in table 3. More than half of the respondents (57%) considered the library as being quiet while 2% rated the library as being extremely quiet. About 29% of the respondents considered the library as being noisy while 8% and 5% indicated that the library as very noisy and extremely noisy respectively. Meanwhile, exactly half of the respondents considered the extent of disruption as "slightly" while 39% and10% were of the opinion that disruption in the library was "much" and "very much" respectively. About 1% of the respondents were not distracted by library noise. The inference is that more than half of the surveyed population thinks the library is quiet; a quarter thinks it is noisy; while disruptions are moderate or abundant.

Table 3: Subjective Rating of Library Indoor Environment and Extent of Disruption by Noise

Noise rating	No.	(%)	Extent of disruption	No.	(%)
Extremely quiet	53	8	Very Much	66	10
Quiet	387	57	Much	263	39
Noisy	196	29	Slightly	340	50
Very noisy	32	5	Not at all	10	1
Extremely noisy	11	2	Cannot say	0	0
Total	**679**	**100**	**Total**	**679**	**100**

The fluctuation of SPL (Sound Pressure Level) in the library during daytime (8am-6pm) in the basement, ground floor, and first floor is shown in Fig.1, Fig. 2, and Fig. 3 respectively. The basement recorded three peaks (>70 dB(A)); 71.6 dB(A) at 8.20 am, 74.1 dB(A) at 4.22pm and 75.7 dB(A) at 12.10 pm. These periods are known to have high library patronage, including the use of equipment and group studying. The minimum SPL was 38 dB(A) at 8.00am – a period where the reading room was empty. All other sound pressure readings fluctuated between 50 dB(A) and 68 dB(A), and are above the recommended values of 35-45 dB(A). In the ground floor, a peak SPL of 72.7 dB(A) was observed at 9.44am; the maximum SPL was 73.8 dB(A) at 11.37am, while another peak of 71.8 dB(A) was recorded at 3.39pm. The minimum SPL was 56.2 dB(A) at 9.02am. It was also observed that the SPL reduced and the readings varied slightly between 58.29 dB(A) and 61.63 dB(A) after 4.06pm. The reduction and slight variability may be attributed to fewer people in the library and less use of equipment. Actually at this period, most library staff members and casual workers have closed for the day and there is equally low patronage by students. In the first floor, a peak of 70.20 dB(A) occurred at 9.07 am while minimum of 47.4 dB(A) was observed at 8.08am. All the recorded sound pressure readings were above the recommended values.

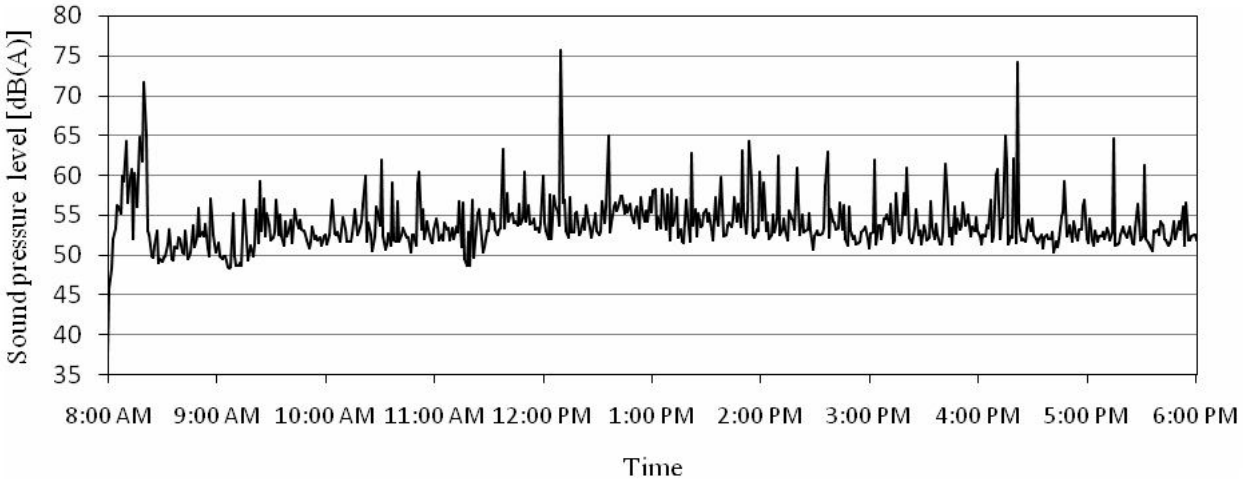

Fig. 1: Pattern of sound pressure fluctuation at the basement

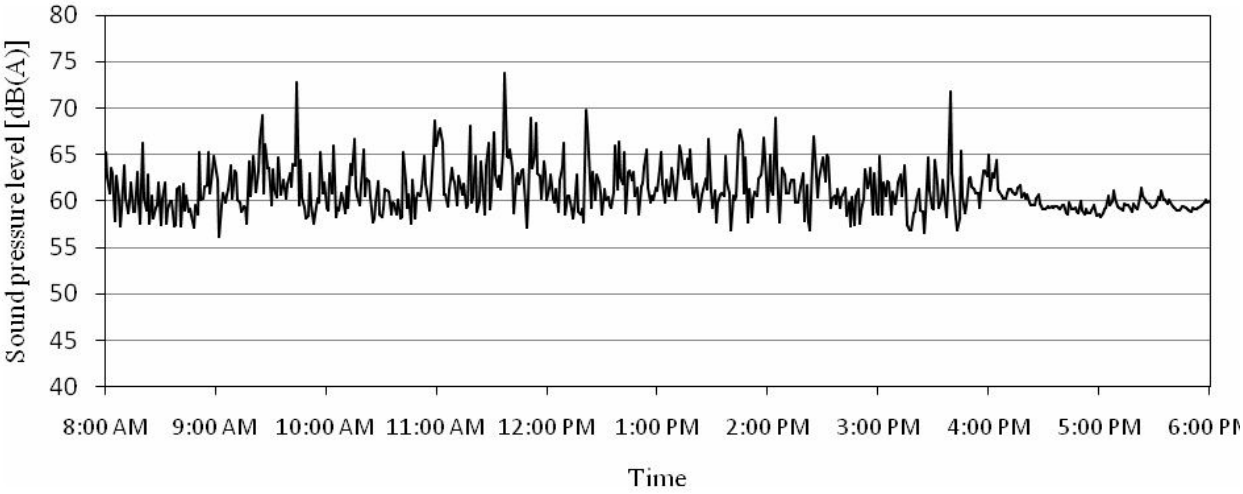

Fig. 2: Pattern of sound pressure fluctuation at the ground floor

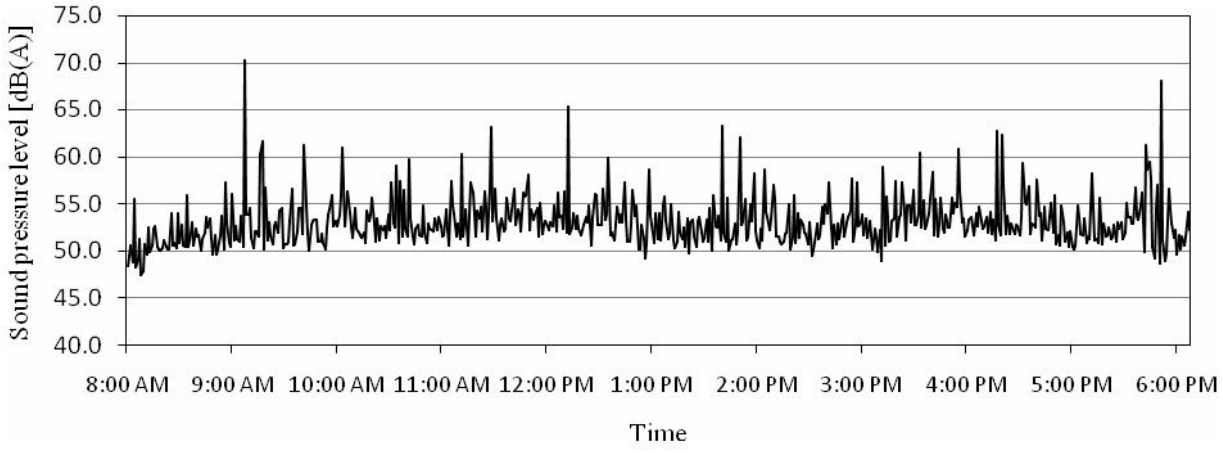

Fig. 3: Pattern of sound pressure fluctuation at the first floor

The fluctuation of SPL in the night (10 pm-7am) is shown in Fig. 4. At this period, the library is empty and all equipment have been turned off. The SPL varies from 31.5 dBA to 36.2 dBA. The calculated L_{eq} value is 32.4 dB(A) which is less than 52 dB(A) specified by FHWA (Federal Highway Administration) (1973) for interior noise of a newly constructed library. A summary of the noise descriptors for the library is presented in table 4. The average Noise Level (L_p) in the library during day-time is 56.85 dBA, Maximum Noise Level (L_{max}) = 73.80 dB(A) , Minimum Noise Level (L_{min}) =38 dB(A), Standard Deviation (ó) = 3.52, Equivalent Noise Level during the study period (L_{eq}) =63.57dB(A) and Noise Pollution Level (L_{NP}) =65.10dB(A). The L_{eq} and L_{NP} value fall within the same range and are greater than the recommended value for indoor library environment. Night-time readings are almost constant (ó=1.6), and are equally quieter (L_{eq} =35.11 dB(A) and L_{NP} =32.40 dB(A)). The difference in L_{eq} between the day-time and the night-time readings is 35.11 dB (A), and it reflects the expected level of noise to be reduced when the library is active.

According to WHO (2004), there is coherent evidence for annoyance in populations exposed to sound levels of 37 dB(A) for more than one year and severe annoyance at about 42 dB(A). In a related research, WHO (1999) observed that during daytime some people are highly annoyed at L_{eq} levels below 55 dB(A) and some are moderately annoyed at L_{eq} levels below 50 dB(A). Furthermore, L_{eq} values greater than 35 dB(A) have critical effects on speech intelligibility, disturbance of information extraction and message communication in indoor reading and learning environments. Evidently, the noise generated in the University of Ilorin Library is above these values and may lead to complaints or lower the use of the library.

The L_{eq} and L_{NP} value are within the same range and the resulting standard deviation (3.52) for day-time readings indicates a bit of uniformity (steadiness) in sound pressure readings. Though human behaviour is complicated, steady noises are always less disruptive than irregular outbursts of noise (Davis and Cornwell, 2009). Reported subjective evaluation of noise (Environment Agency, 2004) rates SPL below 30 dB(A) as quiet; between 30 dB(A) and 60 dB(A) as moderate; and SPL above 70 dB(A) is considered loud. The present empirical L_{eq} value in the library tends to agree with subjective evaluation of the library as being quiet or having moderate noise.

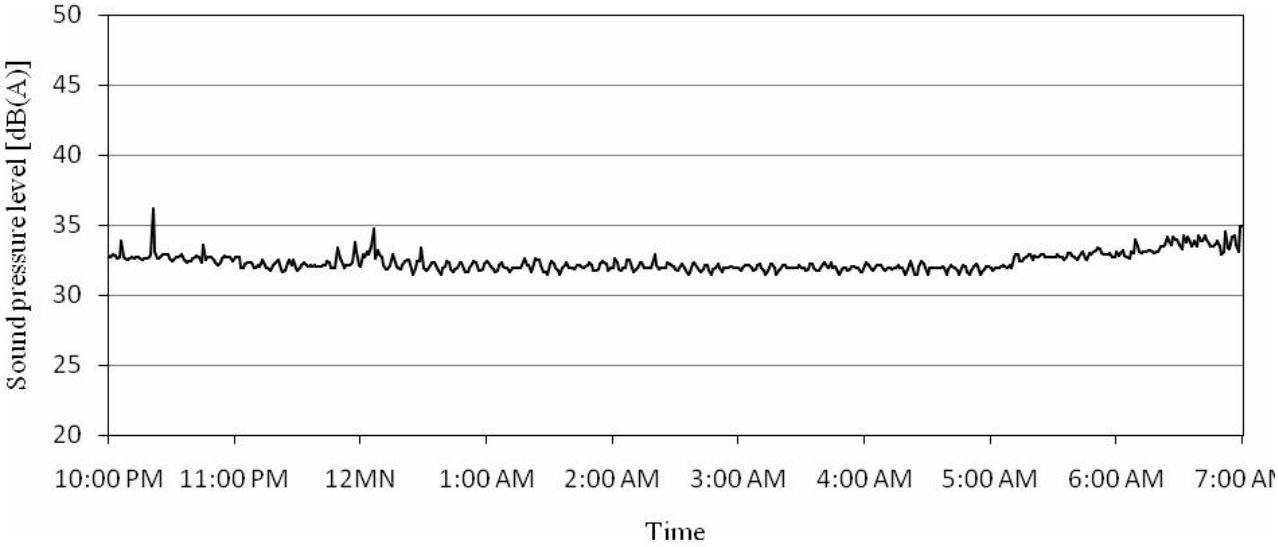

Fig:. 4 Night-time fluctuation in SPL

Table 4: Summary of Noise Descriptors for University of Ilorin Library

Location and period	L_{max} (dBA)	L_{min} (dBA)	L_p (dBA)	σ	L_{NP} (dBA)	L_{eq} (dBA)
Ground floor (daytime)	73.80	56.2	61.51	2.34	69.23	63.24
First floor (day time)	70.20	47.4	53.57	2.67	61.26	54.42
Basement (daytime)	75.70	38.00	54.69	3.36	65.11	56.52
Whole library (day-time)	75.70	38.00	56.85	3.52	65.10	63.57
Whole library (Night-time)	36.2	31.50	32.37	1.06	35.11	32.40

Conclusion and Recommendations

This study used empirical and subjective approaches to assess noise at the University of Ilorin Main Library in Ilorin, Nigeria. The identified major sources of noise in the library were students, library equipment, cell phones, and staff members, while minor distractions and aggravations come from footsteps, personal stereo, trolley wheels, and doors. Individual perception of noise and its effects varies, and it is usually subjective. The day-time noise level during the study period ranged from 38 dB(A) to 73.80 dB(A), and most of the readings were above the recommended limit of 45 dB(A) for library indoor environment. However, the library is quieter at night and the calculated L_{eq} is 35.11 dB(A). Within the library, the ground floor is the noisiest (L_{eq} = 63.24 dB (A)), followed by the basement (L_{eq} = 56.52 dB (A)), while the first floor has an L_{eq} value of 54.42 dB (A). The present empirical L_{eq} value in the library tends to agree with subjective evaluation of the library as being quiet or having moderate noise. It is suggested that the library authority should formulate a policy which will either control or prevent noise in the library. Also, equipment in the library should be maintained to prevent noise, and sound screens or absorbers should be provided in areas where an interior noise source is unavoidable. High, moderate and low noise designated zones should be provided within the library so as to cater for diverse requirement of reading environment and create avenue for group discussions/study, cell phone conversations, playing audio or video games and music, printing photocopying or scanning materials, and using some other equipment which may generate noise.

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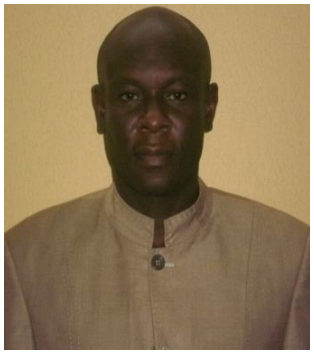

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