Evaluation of indoor Noise Pollution related to human activity in a University Campus in Iraq

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Abstract:

Noise pollution is a global issue that impacts educational environments, reducing the efficiency of both students and teachers. Identifying its causes and sources enables the implementation of effective measures to mitigate noise pollution and protect both the environment and human health. In this study, a field survey was conducted for different locations within the College of Education Campus, Al-Iraqia University. Indoor noise levels were measured for 18 sites at three different times (9:00-11:00 AM, 12:00-2:00 PM and 3:00-5:00 PM) using a sound level meter type (AS-M524). Noise measurements showed that the highest average noise level was recorded during the afternoon, followed by the morning and evening, respectively. The equivalent continuous noise level (L_{eq}) was measured for all readings, the lowest average of equivalent continuous noise level is 63.45 dB at the site Plant Lab, while the highest average of equivalent continuous noise level is 80.06 dB at the site Artificial Intelligence Lab. The average L_{eq} noise level in the College of Education Campus, Al-Iraqia University is 71.37 dB which exceeds the permissible limits set by both local and international standards for educational institutions, due to the diverse noise sources within the College of Education Campus result from student activities, administrative tasks, and external environmental factors.

Keywords: : Indoor noise pollution; The SL meter (AS-M524); Equivalent continuous noise level; Artificial Intelligence Lab; College of Education Campus, Al-Iraqia University.

تقييم التلوث الضوضائي الداخلي المرتبط بالنشاط البشري في الحرم الجامعي في العراق

حوراء خلف عايد

قسم الفيزياء، كلية التربية، الجامعة العراقية، بغداد، العراق

مستخلص:

يعتبر التلوث الضوضائي مشكلة عالمية تهدد البيئة التعليمية وتؤثر سلبا على كفاءة الطالب والمدرس، من خلال معرفه اسبابه ومصادره يمكن اتخاذ خطوات فعالة للحد منه وحماية البيئة وصحة الانسان. في هذه الدراسة تم اجراء مسح ميداني لمواقع مختلفة داخل الحرم الجامعي لكلية التربية الجامعة العراقية. تم قياس مستويات الضوضاء الداخلية لـ 18 موقع في ثلاث فترات زمنية مختلفة (11-9 صباحًا، 2-12 ظهرًا و5-3 مساءً) باستخدام مقياس مستوى الصوت من نوع (AS-M524) . بينت قياسات الضوضاء ان اعلى معدل لمستوى الضوضاء خلال فترة مابعد الظهر ويتبعه الصباح ثم المساء على التوالي. تم قياس الضوضاء المكافئ المستمر(L_{eq}) لجميع القراءات، كان ادنى معدل للضوضاء المكافئ المستمرهو 63.45 dB في موقع (مختبر النبات)، بينما اعلى معدل للضوضاء المكافئ المستمر هو 80.06 dB في موقع (مختبر الذكاء الاصطناعي). يبلغ معدل مستوى الضوضاء المكافئ في حرم كلية التربية، الجامعة العراقية 71.37 dB وتتجاوز الحدود المسموح بها محليا وعالميا للمؤسسات التعليمية، وذلك لتنوع أسباب الضوضاء داخل حرم الكلية، وهي غالبًا ما تكون نتيجة للأنشطة الطلابية والإدارية، بالإضافة إلى العوامل البيئية المحيطة.

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1. Introduction

Noise is generally defined as any unwanted or disruptive sound that negatively affects speech clarity, sleep quality, and work performance. Noise pollution is one of the major environmental concerns globally due to urbanization and modernization [1, 2]. Noise pollution is considered the third most hazardous pollution after air and water pollution, according to the World Health Organization (WHO) [3]. Noise significantly contributes to the degradation of living conditions and the overall quality of life in urban areas. It affects various aspects of people's lives, including work and educational activities, extending beyond industrial settings [4]. Noise stress is linked to an increased risk of disease development [5]. Numerous epidemiological studies have demonstrated that long-term exposure to noise pollution can lead to metabolic, cardiovascular, and respiratory diseases [6]. In addition, exposure to noise has been shown to have adverse psychological and mental effects, such as anxiety and depression [7, 8].

Many studies have reported that educational institutions frequently have noisy learning environments, and the noise is constantly getting worse [9]. Noise in universities has a direct negative impact on learning by increasing distraction and annoyance [10]. According to several studies, excessive noise is bad for teaching and learning because it distracts students, lowers their attention span and cognitive abilities, makes it difficult for them to hear and comprehend their teachers, and reduces their hearing [11]. Noise pollution has recently been identified as one of the most significant environmental factors affecting quality of life in all countries, particularly in urban areas. Environmental noise pollution levels are rapidly increasing over time due to the rapid increase in human activities such as transportation, industrialization, and urbanization [12, 13].

The WHO describes noise as follows: the background noise level should not exceed 35 dB equivalent sound level (L_{eq}) during teaching classroom, while outside the classrooms the sound pressure level of the noise from external sources should not exceed 55 dB L_{eq}, the same value given for outdoor residential areas during the day [14], These noises can originate from a vari-

ety of sources, including noise around the university, background noise from classrooms, and sounds produced during class activities, club activities, and sports. Several factors influence indoor acoustics, including classroom size, background noise within the classroom, instructional style, and vocal effort [15]. Non-acoustic factors, such as psychological and social aspects, are thought to influence annoyance by changing people's awareness and attitudes toward noise. Moreover, previous studies have demonstrated that subjective sensitivity to noise is an important indicator of noise annoyance [16].

However, due to differences in regional culture and economic development levels, the noise climate of cities in different regions is significantly different, and it is difficult to understand the general level of sound environment in colleges and universities [17], According to (Çolakkadıoğlu, et al. ٢٠١٨), noise levels above 35-65 decibel can cause anger and sleep disturbance, while levels above 65-90 decibel can cause high blood pressure and rapid breathing, depending on individual sensitivity [18].

In countries with severe social problems such as Iraq, educational noise is quite uncommon on the list of priorities, and thus has received very little attention. Nowadays, many pollutants are released into the environment with their associated risks to human health. Noise pollution is one of the various anthropogenic pollutants. Movement of hundreds of thousands of cars, industrial activities, and constructions in large cities are the main sources of noise pollution [19], so the study aims to evaluate indoor noise pollution in different sites on the College of Education Campus, Al-Iraqia University. This paper is based on a field study and analysis of data obtained through the use of noise pollution devices, comparing the results with the standards set by The World Health Organization (WHO) and noise control law of the Republic of Iraq.

2. Materials and Methods
2.1. The Study Area
The study area is the College of Education Campus, Al-Iraqia University, lies between latitude (33°37'37.7" North) and longitude (44°14'11.7" East). The College covers 5000 m²

of land and situated on the north of Baghdad capital, and 40 km distance from the city capital center. The college building bounded on the North Al-Rasheed University, on the East and South Agricultural gardens, while on the West by Traffic Street. The College hosts eight departments (Physics, Computer Science, Chemistry, Biology, History, Arabic Language, Quran Sciences and Islamic Education, as well as Educational and Psychological Sciences).

Apart from these it also consists of a central library and books library with a capacity of 30 people. There are many classrooms and science laboratories accommodate 50 and 20 students or people respectively. In the current study, eighteen different types of sites (St1, St2,…St18) were selected for measuring indoor noise levels on the college of education campus as shown in Table 1 and Fig. 1.

Table 1: Names and GPS position of sites at which measurements were taken in the College of Education Campus, Al-Iraqia University.

Site-ID	Site name	Latitude (° N)	Longitude (° E)
St1	College gate	33.627357	44.236674
St2	Scientific Library	33.627271	44.236953
St3	Student Club	33.626684	44.236763
St4	Physics Department	33.626622	44.236484
St5	Computer Department	33.626653	44.236494
St6	Biology Department	33.626738	44.236511
St7	History Department	33.627063	44.237017
St8	Arabic Language Department	33.627141	44.236977
St9	Educational and Psychological Sciences Department	33.626980	44.236961
St10	Mechanic Lab	33.626958	44.237165
St11	Artificial Intelligence Lab	33.626701	44.236942
St12	Organic Chemistry Lab	33.626756	44.236240
St13	Plant Lab	33.626752	44.237058
St14	Classroom 2	33.627073	44.236277
St15	Classroom 10	33.627382	44.236299
St16	Classroom 25	33.626881	44.236261
St17	Classroom 28	33.626613	44.236234
St18	Classroom 35	33.626667	44.237028

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Figure 1: Map of the study area College of Education Campus, Al-Iraqia University.

recordings.

2.2. Equipment and Methodology

The noise level (dB) was measured using a sound level (SL) meter model (AS-M524), this instrument is manufactured by (ASWAR Company) Iraqi origin. It has a sound level measurement range from 30 to 130 dB, with a frequency response spanning from 8.5 to 31.5 KHz. Its measurement accuracy is ±1.5 decibels. The SL meter accurately captures and displays the minimum and maximum sound pressure levels measured during the specified time interval. The results are presented on the LCD screen as shown in Fig. 2. The microphone was placed 1.5 to 2 meters above the ground to minimize sound reflections and ensure accurate

The Noise levels (dB) were measured at three different times. (9:00-11:00 AM, 12:00-2:00 PM and 3:00-5:00 PM) to capture the high sound levels of students during entry and exit from the campus. These measurements were carried out in 18 points from Sunday to Thursday during study hours. The SL meter was used to measure noise level in decibel scale over five minutes for each reading.

This meter includes two scales (A-high and low frequency-weighting) and (C-high frequency-weighting). A-weighting scale was adopted in the measurements to capture different high and low sound frequencies such as the sounds of academic activities in

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the classroom and the loud voices of students, as well as the quiet sounds during writing and reading, etc.

The noise levels measurements during the morning, afternoon and evening can be converted to the equivalent continuous noise levels (L_{eq}), which is a single-number metric used to represent the average noise level over a specific period، calculated using the Equation (1) [20, 21].

$$L_{eq} = 10.\log_{10} \sum_{i=0}^{n} \{(10^{L_i/10}) \times t_i\} \cdots(1)$$

Where L_i the noise level (dB), n is the total number of reading data taken, and t_i is a fraction of total reading time (hour). The total continuous equivalent noise level in the study area was also calculated using the formula in Equation (2) [20].

$$\text{Total Average } L_{eq} = \frac{L_{eq}\text{Point 1}+L_{eq}\text{Point2}+\cdots L_{eq}\text{Point n}}{n} \quad \cdots\cdots(2)$$

Fig. 2: Sound level meter (AS-M524) used in the present work.

3. Results and Discussions

In this study, the results of average minimum and maximum indoor noise level for the College of Education Campus, Al-Iraqia University presented in Table 2. The results showed that the average minimum noise level of 54.03 dB was recorded at site St7 (History Department), while the highest noise level of 84.94 dB was recorded at site St11 (Artificial Intelligence Lab).The location of the AI Lab near the generator that supplied the college building with electricity could cause significant noise-related annoyance, as per WHO guidelines [22, 23].

By comparing the period of average noise levels in the College building as shown in Table 3, the study revealed that the total average of lowest noise pollution is recorded during the evening 60.95 dB, followed by morning 69.44 dB and highest in afternoon 72.9 dB ascending (Fig. 3), the values of average noise level exceed the limits permitted by the (WHO) for indoor educational noise, which is 35 dB [24]. This result corresponds to the period when academic activities (lectures, workshops, study groups, academic clubs... etc.) within the College of Education Campus are at their peak. The result is consistent with the study conducted by (Amakom et al. 2019) at the Federal University of Technology, Owerri and (Idu et al. 2024) at the University of Nigeria, Enugu Campus which showed that the highest level of noise pollution at 12.00 PM was 71.07 dB and 71.56 dB respectively [25, 26].

Table 2: Average minimum and maximum indoor noise level in the College of Education, Al-Iraqia University.

Site-ID	L_{min} (dB)			L_{avg} (dB)	L_{max} (dB)			L_{avg} (dB)
	9-11 AM	12-2 PM	3-5 PM		9-11 AM	12-2 PM	3-5 PM	
St1	62.81	74.08	52.55	63.15	84.61	90.02	71.18	81.94
St2	52.33	61.62	50.17	54.71	75.82	88.54	69.77	78.04
St3	62.9	71.25	53.47	62.54	82.90	93.50	70.09	82.16
St4	63.73	66.07	52.61	60.80	78.55	77.23	68.43	74.74
St5	48.01	66.33	48.20	54.18	73.03	81.14	67.04	73.74
St6	71.75	68.26	55.39	65.13	85.22	80.82	78.50	81.51
St7	50.06	57.10	54.92	54.03	79.19	76.26	71.87	75.77
St8	68.92	60.41	58.43	62.59	80.51	67.92	68.19	72.21
St9	62.80	54.06	48.11	54.99	84.34	88.28	75.22	82.61
St10	50.77	61.81	53.06	55.21	65.06	76.51	67.91	69.83
St11	69.89	73.55	56.12	66.52	82.70	94.11	78.00	84.94
St12	58.25	57.38	50.61	55.41	77.42	82.12	66.48	75.34
St13	56.44	59.01	54.97	56.81	72.18	70.01	62.61	68.27
St14	50.38	70.26	49.08	56.57	65.80	81.25	55.70	67.58
St15	60.56	56.52	59.27	58.78	74.79	70.06	70.06	71.64
St16	71.61	72.61	53.51	65.91	83.20	84.39	65.80	77.80
St17	62.42	64.80	47.06	58.09	78.93	82.17	60.33	73.81
St18	70.03	58.24	57.20	61.82	82.07	86.62	72.41	80.37

Table 3: Average noise pollution measurements for the study sites during
three time periods: Morning, Afternoon, and Evening (dB).

| Site-ID	L_{avg} (dB)-Morning	L_{avg} (dB)-Afternoon	L_{avg}(dB)-Evening
St1	73.71	82.05	61.87
St2	64.08	75.08	59.97
St3	72.90	82.38	61.78
St4	71.14	71.65	60.52
St5	60.52	73.74	57.62
St6	78.49	74.54	66.95
St7	64.63	66.68	63.40
St8	74.72	64.17	63.31
St9	73.57	71.17	61.67
St10	57.92	69.16	60.49
St11	76.30	83.83	67.06
St12	67.84	69.75	58.55
St13	64.31	64.51	58.79
St14	58.09	75.76	52.39
St15	67.68	63.29	64.67
St16	77.41	78.50	59.66
St17	70.68	73.49	53.70
St18	76.05	72.43	64.81
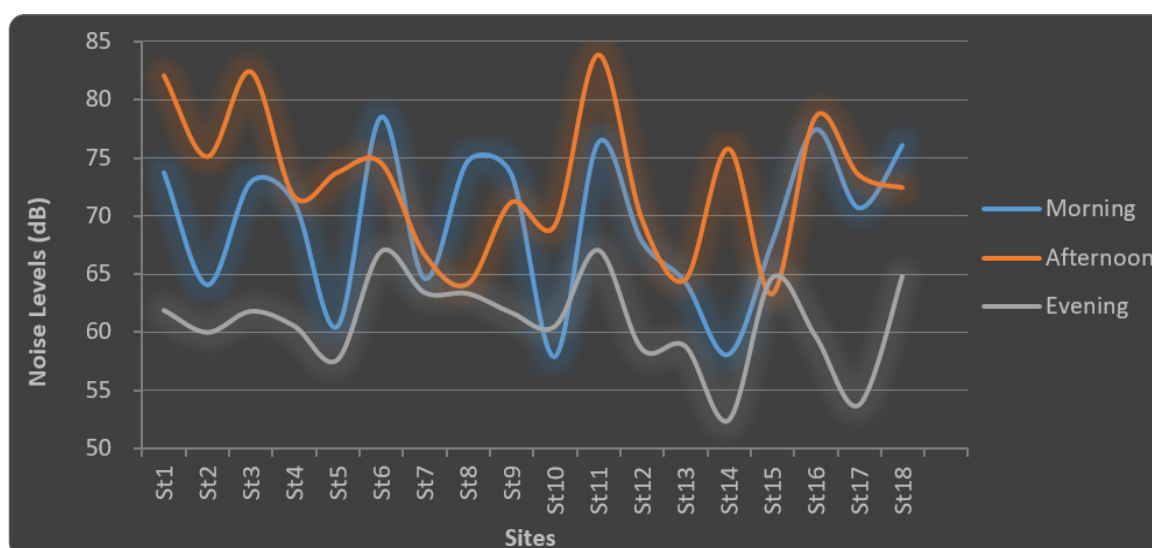
Fig. 3: Variation of indoor noise levels at three different times and locations
on the Campus of the College of Education, Al-Iraqia University.

In the current study, the sound intensity during the evening is low due to the approaching end of lectures and the departure of students and academic staff the College while, the educational noise during the afternoon is noisy. Table 4 indicates the average equivalent continuous noise level (L_{eq}) of 18 locations on the College of Education Campus, Al-Iraqia University; the site St13 (Plant Lab) recorded the lowest L_{eq} of 63.45 dB, while the site St11 (Artificial Intelligence Lab) recorded the highest noise level with L_{eq} 80.06 dB, as shown in the Fig. 4. The total average equivalent noise level was calculated using the formula in Eq. (2). The results indicate that the total average equivalent continuous noise level on the College of Education Campus is 71.37 dB. The L_{eq} noise level results reported in the current study are extremely high and surpass the limitations permitted by the (WHO) for indoor educational noise, which is 35 decibels [24] and The Republic of Iraq's Noise Control Law, which ranges from (50-55) dB [27].

The indoor noise pollution experienced within the College of Education Campus, Al-Iraqia University could be attributed to a small area of the college building and inappropriate engineering design to absorb high sounds causing noise. This finding is consistent with [28], who observed that a larger building causes more severe sound attenuation, the result of the study can reflect the circumstance related to university buildings that are large enough to absorb noise. The study showed that noise levels were highest in the afternoon, between 12:00 and 2:00 PM, this could be attributed to the time students crowded in the student club to take lunch, as well as the construction and maintenance activities and the sounds of machinery on campus. These contribute to a high noise level that exceeds permissible limits during the day.

The location of the College Campus near the traffic increases noise pollution due to the sound coming from vehicles movement. Most of the classrooms were close to the traffic, and students suffered from the loud noise coming from them, this result confirms the study by (Bala & Verma 2020) which established that increasing traffic is major source of noise pollution [29]. According to the World Health Organization, noise levels above 35

decibel during training distract students and make learning difficult, noise levels between 45 and 60 decibel disrupt sleep, and noise levels above 55 decibel cause students to feel more anxious [30]. When comparing the noise pollution measurements in this study with those recommended by international and local regulations, it is noted that the noise on the campus of the College of Education is not suitable for the educational area, which may cause physical and psychological problems for the academic community.

Table 4: The equivalent continuous noise level
in the College of Education, Al-Iraqia University.

Site-ID	L_{eq} (dB)-Min.	L_{eq} (dB)-Max.	L_{eq}(dB)-Avg.
St1	69.65	86.39	78.02
St2	57.60	84.05	70.83
St3	67.13	89.11	78.12
St4	63.42	76.42	69.92
St5	61.69	77.14	69.41
St6	68.65	82.42	75.54
St7	54.89	76.71	65.80
St8	65.05	76.21	70.63
St9	58.70	85.13	71.92
St10	57.87	72.57	65.22
St11	70.39	89.74	80.06
St12	56.47	78.70	67.59
St13	57.13	69.76	63.45
St14	65.57	76.61	71.09
St15	59.09	72.25	65.67
St16	70.41	82.11	76.26
St17	62.06	79.10	70.58
St18	65.74	83.27	74.51

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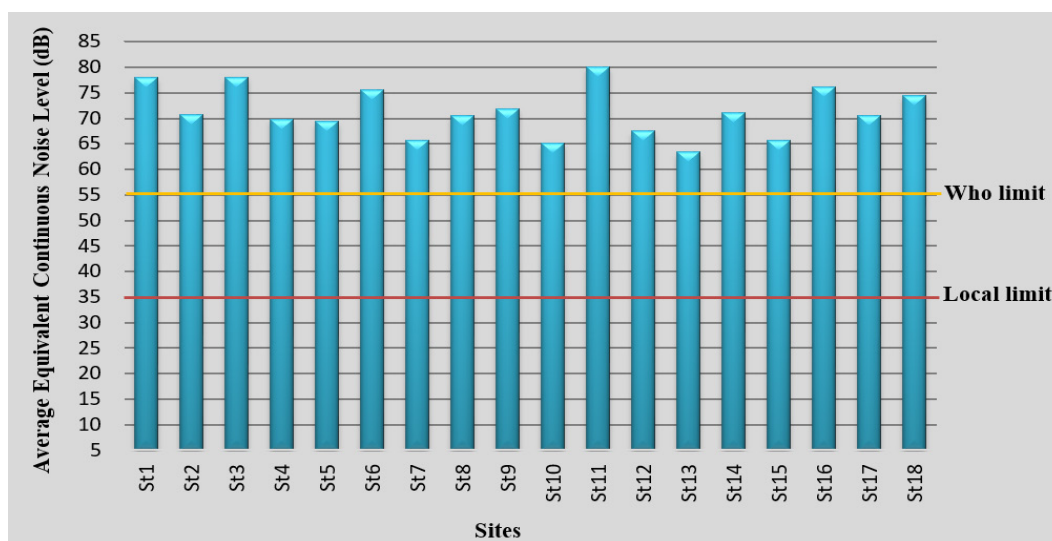العدد الخامس والعشرون - المجلد الأول - علوم الفيزياء - آذار 2025م

Fig. 4: Average equivalent continuous noise level
in the College of Education, Al-Iraqia University.

4. Conclusions

Humans were found to be the primary contributors to noise pollution, often stemming from a lack of awareness and behavioral issues among individuals. Indoor noise levels were measured at the College of Education, Al-Iraqia University using a sound level meter (SL). Poor engineering design, improper placement of construction and maintenance activities, traffic, and various student activities contribute to increased noise levels within the college campus. The measurement was done using a formula of the equivalent continuous noise level (L_{eq}). In all measurement sites, the average values of equivalent continuous noise levels exceeded recommended noise limits at three different times (morning, afternoon, and evening), which could make students, staff, and lecturers feel quite disturbed according to the WHO indoor educational noise exposure guidelines.

5. Recommendations

The field study recommended taking preventive measures to control noise pollution in educational settings, the most important of which is restricting vehicle movement both inside and outside the college campus. Use sound-absorbing materials in college buildings and establish a greenbelt by

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planting numerous trees around the college building and along nearby external roads. Raising awareness about noise pollution and its harmful effects on human health through posters, voluntary media activate the tasks of the specialized medical team inside the university campus to provide a healthy educational environment. Implement progressive financial fines for those contributing to noise pollution and establish a network to monitor environmental noise levels.

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