Classrooms Acoustic Evaluation to Enhance Quality of Teaching and Learning in Higher Education Institutions

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A B S T R A C T

The acoustical condition in the classroom frequently affects the quality of teaching and learning activities in higher education Institutions. Lecture activities require a favorable environment that is free of noise. The study aims to assess the acoustical condition of the C101 classroom, Engineering Faculty, Abulyatama University. Data collection was conducted by measuring Background Noise Levels and student perception of noise using a set of questionnaires. The result revealed that the average background noise level (BNL) measured in the classroom is 56,9 decibels. It shows that the BNL measured is greater than the noise permitted by the Indonesian government for the education area. The primary cause of this noise is the student's activity inside the classroom during learning activities. In general, respondents are likely able to deal with noise existence within the classroom.

I. Introduction

Classroom conditions are one of the determining factors in the success of teaching and learning activities in higher education Institutions. Interior design, temperature, lighting, and sound intensity are the main factors influencing the comfort of a lecture room. High sound intensity can be the biggest problem in lecture activities; study, discussion, and teaching sessions [1]. Noise, such as unwanted sounds in a classroom, may disrupt the learning process, which causes difficulties for students to digest the information obtained. In terms of source, noise can be divided into two groups, namely interior noise and outdoor noise [2]. Interior noise is a source of noise created by human voices, household appliances, and building machines. Meanwhile, external noise comes from traffic, industry, mechanical equipment outside buildings, construction activities, etc. For this reason, acoustic comfort in designing lecture halls must be considered [3].

In addition, the World Health Organization (WHO) defines noise as unnecessary sound affecting the quality of life, health, and well-being. Sound is called noise if its intensity exceeds 50 dB [4]. The noise threshold value (NAB) set by the Indonesian Minister of Environment Decree No. 58 of 1996 for the education environment is 55 dB [5]. Moreover, Minister of Health Regulation Number 718 of 1987 stated the permitted noise level for housing, educational, and recreational areas is 45-55 dB [6]. Noise levels outside the specified number can negatively influence the human body physiologically and psychologically [7]. Noise's impact on human health varies by intensity, frequency, and duration of exposure [8]. The longer our ears listen to noise, the worse the effects on our body, one of which is a decreased ability to hear. The school environment is no exception to being exposed to noise problems. Therefore, research on noise levels in academic settings is needed.

To date, numerous research has looked into how noise affects lecture surroundings. The acoustical condition of the classroom should be such that good listening quality can be achieved without the

vocal effort of teachers. However, there is commonly always some background noise in the classroom setting [9]. It generally requires specific materials that are capable of reducing the noise level at various frequency ranges [10]. A classroom with acoustically treated walls resulted in higher speech intelligibility. A comfortable classroom will provide a conducive learning atmosphere that makes students more focused without being distracted by environmental conditions. An uncomfortable environment results in a decrease in the effectiveness of an activity, both the process and the results. A comfortable environment provides appropriate interaction between students and lecturers. The material presented can be well received by students in the learning process runs well. There is a strong correlation between the useful-to-detrimental ratio and the speech transmission index for speech intelligibility, which evaluates nearly the same aspects of university courses [11].

To provide an appropriate teaching and learning environment, evaluation of education facility performance is essential to be taken into account [12]. Likewise, noise control is a matter of great interest due to the need for institutions to facilitate the transfer of knowledge with a high level of attention of students in an adequate approach [13]. This research aims to analyze acoustical conditions during lecture activities in the C101 lecture room, Engineering Faculty, Abulyatama University. The object is located directly facing the main road on campus. Additionally, its location is close to the construction activity of a new building. The results of this research would become a reference for building management and lecture conditions at the higher education Institutions.

II. Method

In this study the background noise level (BNL) was assessed using a smartphone-based sound level meter, named a decible meter app. The measurement of noise circumstances begins with the volume of the lecture hall. Testing is exclusively done in the lecture room. The BNL collected in this study are then compared to the noise quality standards established by the Indonesian government. Questionnaires are given to students during actual teaching and learning activities. The questionnaires ask students about their perceptions of loud lecture settings, noise sources, and the influence of noise on learning.

III. Results and Discussion

A. Classroom Condition

The object of this study is the acoustical condition of the C101 lecture room, Engineering Faculty, Abulyatama University. The lecture room is located facing the main road on the Abulyatama University campus. The floor plan of the C101 lecture room is shown in Fig.1.
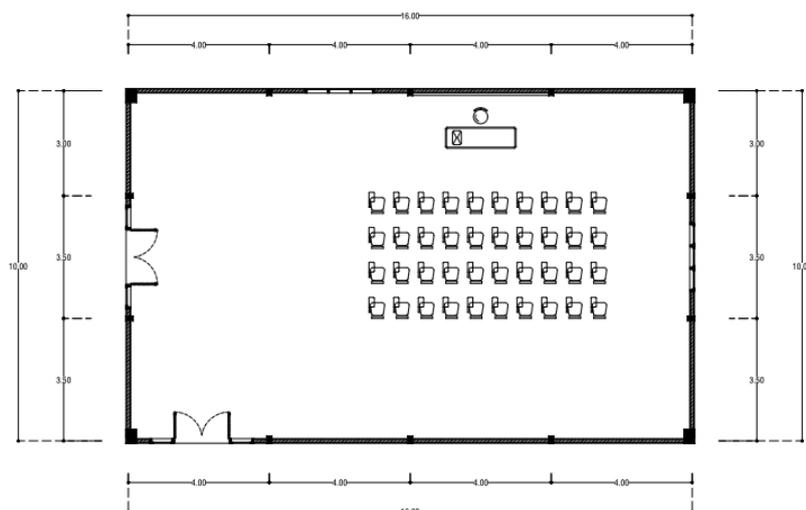

Fig. 1. Classroom Condition

The C101 lecture room measures 160 m², with a classroom length of 16 m, width of 10 m, and ceiling height of $\pm$ 3 m (see Fig.1). It can house around 70 pupils. The classroom's west and east walls have openings glass windows that allow plenty of natural light and air circulation. The wall is

completely covered in concrete, whereas the floor is completely covered in ceramic material. The classroom was organized in a traditional "row by row" configuration. The students' desks faced the blackboard or the interactive screen, where lecturers delivered their courses.

B. Background Noise Level

The The results of measuring the background noise level (BNL) in the C101 classroom at the Faculty of Engineering, The University of Abulyatama are shown in Table 1.

Tabel 1. Background Noise Level (BNL)

	Background Noise Level (dB)
Ministry of Health	45-55
Kep-Men LH	55
C101 Lecture Room	56,9

Table 1 illustrates that noise problem dosages exist within the C101 lecture room of the Engineering Faculty at Abulyatama University. The average background noise level (BNL) measured inside the C101 lecture room at the Engineering Faculty of Abulyatama University is 56.9 decibels. Thus, the BNL measured within the C101 lecture room does not meet the requirements specified by the Indonesian Ministry of Health and the Indonesian Ministry of State Environment. The value is higher than the Indonesian government's quality standard for educational setting noise, which is lower than 55 decibels. As a result, there was a strong link between background noise levels and classroom quality. A high level of background noise negatively impacts student speech perception and instructor vocal hygiene during teaching activities.

C. Student Perceptions of Noise

Describing a sound as noise is subjective. It depends on the individual's internal state. Individuals may have different responses to the same auditory stimulation [14]. When the measurement took place, the C101 classroom had a total of 66 pupils. A survey questionnaire was used to acquire these students' perceptions of the noise level within the lecture room. The questions covered classroom noise conditions, the source of noise in the classroom, and disturbance to classroom activity. The survey findings are displayed in Figures 2, 3, and 4. The following (Fig.2) shows the results of a questionnaire on the noise level in the C101 lecture room of Engineering Faculty in the University of Abulyatama during teaching and learning activities.
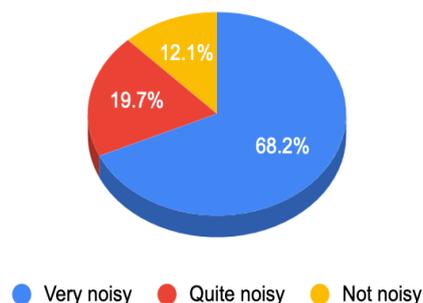

Fig. 2. Noise Condition

Figure 2 demonstrates that the majority of respondents agree that the noise level in the C101 lecture room at the Faculty of Engineering at the University of Abulyatama is not a problem. 68.2% of respondents agreed that the room is noisy, 19.7% said it is very noisy, and only 12.1% stated it is not noisy. When asked about the source of the noise, 72.6% said it was caused by students in the classroom and 11.3% by students outside the classroom. The remaining 16.1% of respondents indicated that there is no noise around them (Fig. 3).
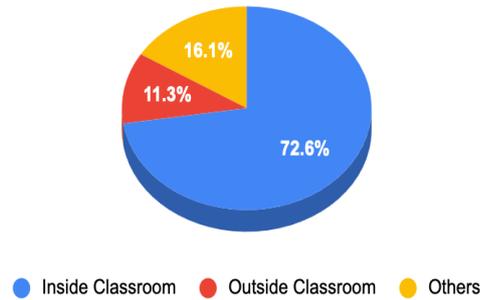
Noise Source

Fig. 3. Noise Source

Figure 3 indicates that the source of noise in the C101 classroom could be both internal and exterior noise. According to the data collected, the noise in the vicinity is caused by student speech, student activities, and a fan. Meanwhile, exterior noise is caused by traffic, student voices, and activity in other classrooms when there are no lectures. One of the primary causes of noise in the educational environment is the enormous number of students. Delays in starting lectures can cause a lack of learning activities during active lecture hours. Furthermore, the lecture hall is directly facing the main road in University, thus traffic movement in front of the room can be a source of noise.
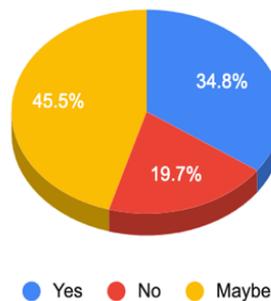
Noise Disturbance

Fig. 4. Noise Disturbance

According to the data in Fig. 4, 34.8% of respondents agree that a noisy environment has an impact on teaching and learning activities. This means that noise pollution in the lecture hall should be managed. On the other hand, 19,7% of respondents said a noisy setting did not affect their learning activities, while 45.5% were unsure. Based on the statistics, it is reasonable to conclude that learning settings in the C101 classroom are free of noise. Thus, no interruptions occur during lectures. Lecture activities at the C101 lecture room, Engineering Faculty, Abulyatama University, continued in a peaceful and quiet atmosphere. Thus, noise exposure in regular classrooms presented no risk of noise-induced hearing damage.

IV. Conclusion

Based on the research findings, it is possible to conclude that the average background noise level (BNL) measured in the C101 lecture room at the Engineering Faculty of Abulyatama University is 56.9 dB. The measured BNL value does not meet the minimum standard for noise levels in educational settings. The main source of this noise is internal noise, which includes student voices, activity, and fans. 34.8% of respondents confirmed that a noisy environment has an impact on teaching-learning activity, whereas 19.7% disagreed. In general, people had no problem with noise. Thus, instructional activities at the C101 lecture room, Engineering Faculty, Abulyatama University, were conducted in a comfortable environment.

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