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Analysis of Environmental Noise Levels and LTM_{10} Values at Sumbawa University of Technology and Their Compliance with the Threshold Limit Value

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ABSTRACT
Environmental noise represents a form of physical pollution that may interfere with comfort and academic concentration in educational settings. This study aims to analyze environmental noise levels at Sumbawa University of Technology using the 10-minute equivalent continuous sound level (LTM_{10}) and to assess their compliance with the applicable Threshold Limit Value (TLV). Measurements were conducted at four strategic campus locations: the Rectorate Building frontage, the Faculty of Environmental and Mineral Technology (FTLM) roundabout, the Integrated Laboratory (ITL) intersection, and the SIKIM intersection. Each site was monitored for 10 minutes using a Sound Level Meter (SLM). The recorded LTM_{10} values ranged from 57.50 to 77.54 dB(A), with the highest level observed at the ITL intersection and the lowest at the FTLM roundabout. All locations exceeded the 55 dB(A) noise limit for educational areas as stipulated in Decree of the Minister of Environment No. 48 of 1996, although they remained below the occupational exposure limit of 82 dB(A). These results indicate that campus noise levels have surpassed acceptable acoustic comfort standards, underscoring the need for effective noise mitigation strategies to enhance the quality of the learning environment.

1. INTRODUCTION

Noise pollution has become an increasingly important environmental issue in many urban areas. The rapid expansion of cities, the growth of transportation systems, and the intensification of human activities have significantly contributed to rising environmental noise levels in public spaces. University campuses, which function as centers for education, research, and social interaction, are also exposed to this problem. Various campus activities, including academic discussions, vehicular movement, and infrastructure development, may generate considerable levels of environmental noise. According to the World Health Organization (WHO), long-term exposure to environmental noise exceeding recommended limits may lead to several adverse health effects such as sleep disturbance, increased stress, hearing impairment, and decreased cognitive performance (World Health Organization, 2018). For this reason, environmental noise is increasingly viewed not only as an acoustic inconvenience but also as an environmental health concern that may affect the quality of life.

In educational environments, maintaining a relatively quiet and comfortable atmosphere is essential for supporting effective teaching and learning processes. Activities such as lectures, group discussions, independent study, and research require an environment where communication can occur clearly and concentration can be maintained. However, many universities are located in rapidly developing urban regions where transportation density and surrounding human activities continue to increase. Under these conditions, environmental noise may become a factor that disrupts academic activities. High noise levels can interfere with verbal communication in classrooms, reduce students' ability to focus, and lower the overall comfort of the learning environment. Previous studies in environmental health also categorize educational facilities as noise-sensitive areas because the success of educational activities strongly depends on favorable acoustic conditions (Clark & Paunovic, 2018) (Fredianelli et al., 2022).

A number of international studies have examined the broader impacts of environmental noise exposure. Research by Mathias Basner and Wolfgang Babisch reported that environmental noise can contribute to sleep disturbance, elevated blood pressure, and long-term stress responses (Basner & MDWolfgang Babisch, 2014). In addition, studies conducted by Stephen Stansfeld and Charlotte Clark suggest that younger populations, including university students, may be particularly sensitive to noise exposure. High environmental noise levels have been associated with decreased reading performance, reduced attention span, and lower academic achievement (Stansfeld & Clark, 2015). These findings indicate that noise management in educational environments is not only relevant from an environmental perspective but also important for supporting academic performance and student well-being.

Research focusing on environmental noise conditions in university campuses has increased in recent years, especially in urban settings where multiple sources of noise are present simultaneously. Several studies have shown that noise levels in campus areas frequently exceed recommended comfort thresholds. For example, (Huang et al., 2022) reported that environmental noise levels measured at several university campuses were higher than the guideline values suggested for educational environments, particularly in areas located close to major traffic routes. Other studies have also identified vehicular traffic, student mobility, and operational campus activities as important contributors to environmental noise within university environments (Mealings et al., 2024)(Zaffaroni-Caorsi et al., 2025). These findings highlight the need for continuous monitoring in order to better understand the acoustic characteristics of campus environments.

Similar situations have been reported in several Indonesian universities. Measurements conducted at various campuses indicate that environmental noise levels may approach or exceed the recommended limits for educational areas. For instance, research conducted at Universitas Sumatera Utara recorded environmental noise levels ranging from 30.98 dB(A) to 76.54 dB(A) across several measurement points, with some locations exceeding the recommended threshold for educational environments (Adi Rahayu et al., 2024). A study at Universitas San Pedro Kupang also indicated that environmental noise in campus areas has the potential to interfere with teaching and learning activities (Benafa et al., 2024). Furthermore, research conducted around Universitas Negeri Semarang identified a strong relationship between traffic density and environmental noise levels in campus areas, suggesting that vehicular movement represents one of the major contributors to campus noise pollution (Prahmani et al., 2024). These findings suggest that environmental noise within university environments is an issue that requires greater attention in campus environmental management.

Environmental noise may produce impacts that extend beyond physical health concerns to include psychological well-being and academic performance. Continuous exposure to high noise levels may reduce concentration, disturb sleep patterns, and influence cognitive functioning (Aletta et al., 2018)(Fredianelli et al., 2022). Therefore, evaluating environmental noise conditions is an important step in understanding the level of exposure experienced in a particular location and in developing appropriate noise mitigation strategies.

Environmental noise monitoring is commonly conducted using a Sound Level Meter (SLM), which measures sound pressure levels expressed in A-weighted decibels [dB(A)]. The A-weighting scale is widely used because it reflects the sensitivity of the human auditory system to different sound frequencies. The instrument converts fluctuations in sound pressure into electrical signals that are processed into measurable sound levels. International standards such as IEC 61672-1 emphasize the importance of using calibrated measurement instruments to ensure the reliability and accuracy of noise data. Because environmental noise fluctuates continuously, single instantaneous measurements cannot fully represent actual exposure conditions. Consequently, environmental noise assessments generally employ the Equivalent Continuous Sound Level (Leq), which represents the logarithmic average of sound energy over a specific period of time (Fredianelli et al., 2022). One approach frequently applied in dynamic environments, including university campuses, is the ten-minute Equivalent Continuous Sound Level, commonly referred to as LTM_{10}. In this method, A-weighted sound pressure levels are recorded at regular intervals during a ten-minute measurement period and then processed to obtain the equivalent noise level for that duration. This approach is considered capable of representing short-term environmental noise conditions in locations where noise levels fluctuate over time (Garg et al., 2023)(Yalili Kilic & Abus, 2020).

Although numerous studies have examined environmental noise in urban and campus environments, many of them primarily focus on identifying noise sources or mapping general noise levels without examining short-term temporal variations in environmental noise exposure. In addition, studies that specifically apply the LTM_{10} approach to evaluate environmental noise conditions within university campuses in Indonesia remain relatively limited. As a result, there is still limited empirical information regarding how environmental noise fluctuates within short observation periods in campus environments and how these noise levels compare with regulatory standards established for educational areas.

To address this gap, the present study evaluates environmental noise levels at several observation points within the campus of Sumbawa University of Technology using the LTM_{10} measurement approach. The novelty of this study lies in the integration of systematic short-term environmental noise assessment using the LTM10 method with regulatory compliance evaluation in a university campus environment in Indonesia. This approach provides empirical evidence on short-term noise dynamics and contributes to the development of data-driven environmental noise management strategies in higher education institutions.

Based on the background described above, this study aims to: (1) determine environmental noise levels at selected measurement locations during specific observation periods; (2) analyze the calculated LTM_{10} values obtained from field measurements; and (3) evaluate the extent to which the measured noise levels comply with the applicable environmental noise Threshold Limit Value for educational environments. The findings of this study are expected to provide a clearer overview of environmental noise conditions at Sumbawa University of Technology and to contribute to the development of more effective environmental noise management strategies within campus environments.

2. METHOD

2.1. Study Area and Time of Measurement

This study was conducted within the campus area of Sumbawa University of Technology. Several observation points were selected to represent varying levels of campus activity intensity, including high, moderate, and low mobility zones, in order to provide a comprehensive characterization of environmental noise conditions. The selection of measurement locations considered surrounding activity characteristics, including vehicular movement intensity, academic community activities, and the functional use of campus spaces that potentially generate noise. Noise measurements were carried out at four strategic locations with the following schedule:

a) Point 1: In front of the Rectorate Building (main entrance), 08:30–08:40 WITA
b) Point 2: Roundabout of the Faculty of Environmental and Mineral Technology (FTLM), 09:15–09:25 WITA
c) Point 3: Integrated Laboratory (ITL) intersection, 09:50–10:00 WITA
d) Point 4: SIKIM intersection (side entrance of the campus), 10:20–10:30 WITA

Figure 1. The map of the research locations within the campus area.

2.2 Instruments and Materials

The primary instrument used in this study was a Class 2 Sound Level Meter (SLM) compliant with the international standard IEC 61672-1:2013. Supporting equipment included an umbrella to protect the instrument from direct sunlight exposure, a stopwatch to control the measurement duration, and an observation sheet used to record measurement time, duration, environmental conditions (such as temperature and humidity), and noise level readings during the measurement process.

Figure 2. illustrates the instruments used during data collection.

2.3 Noise Measurement Procedure

Noise measurements were initiated by selecting representative observation positions while minimizing the influence of sound reflections. The measurement point was positioned approximately 2–3 meters away from walls, buildings, or other reflective surfaces. The Sound Level Meter was operated at a height corresponding to the average adult ear level, approximately 1.0–1.2 meters above ground level, with the microphone directed toward the dominant noise source.

The instrument was configured using A-weighting frequency response and a fast time response setting to capture continuous environmental noise. The measurement range was adjusted according to the ambient sound intensity. At each location, sound pressure levels were recorded at 5-second intervals over a total observation period of 10 minutes. This procedure generated a series of instantaneous noise level data expressed in dB(A), which were subsequently used to calculate the equivalent continuous noise level. All measurement data were compiled and grouped according to observation location for further analysis.

2.4 Data Analysis Technique

Noise data were analyzed using the 10-minute Equivalent Continuous Sound Level method (LTM_{10}) to determine representative short-term noise exposure. The LTM_{10} value was calculated using the following equation:

$$L_{TM10} = 10 \log_{10}\left(\frac{1}{n}\sum_{i=1}^{n} 10^{\frac{L_i}{10}}\right) \quad (1)$$

where:
L_i = noise level at each observation interval during the 10-minute period [dB(A)]
n = total number of measurement data points

This equation was applied to obtain the equivalent noise level representing the cumulative sound energy over the 10-minute observation interval.

2.5 Evaluation Criteria Based on the Threshold Limit Value (TLV)

The calculated LTM_{10} values at each measurement point were evaluated against the national environmental noise standards stipulated in the Decree of the Minister of Environment No. 48 of 1996 concerning Noise Level Standards. For educational areas, the permissible noise limit is 55 dB(A). These occupational exposure limits were included only as complementary comparative references and were not used as the primary environmental compliance criteria, since this study focuses on environmental noise quality in educational areas.

Table 1. Permissible Noise Exposure Limits

Noise Level (dB)	Maximum Daily Exposure
82	16 hours
83.3	12 hours
85	8 hours
88	4 hours
91	2 hours
94	1 hour
97	30 minutes
100	15 minutes

Source: Ministry of Environment of the Republic of Indonesia. 1996. Decree of the Minister of Environment No. KEP-48/MENLH/11/1996 concerning Environmental Noise Level Standards.
Additionally, environmental noise limits for designated land-use categories include:

Table 2. Environmental Noise Standards Based on Decree of the Minister of Environment No. 48 of 1996

Land Use Category	Noise Limit (dB(A))
Residential areas	55
Commercial and services	70
Offices and trade	65
Green open space	50
Industrial areas	70
Government and public facilities	60
Recreation areas	70
Hospitals	55
Schools	55
Places of worship	55

Source: Ministry of Environment of the Republic of Indonesia. 1996. Decree of the Minister of Environment No. KEP-48/MENLH/11/1996 concerning Environmental Noise Level Standards.

Although the environmental noise threshold limits applied in this study refer to the Decree of the Minister of Environment No. 48 of 1996, which remains the primary regulatory framework for environmental noise standards in Indonesia, additional sector-specific regulations such as the Regulation of the Minister of Environment and Forestry No. P.56/2019 concerning vehicle noise emission standards were also considered as complementary references, particularly in relation to transportation-related noise sources commonly found in university environments.

The evaluation results were used to identify potential environmental noise risks at each measurement location and to determine the necessity for appropriate noise control measures. Locations exceeding the prescribed environmental noise limits were considered to have the potential to cause disturbances to health, comfort, and learning activities, thereby indicating the need for continuous noise monitoring and mitigation strategies within the campus environment.

3. RESULTS AND DISCUSSION

Noise level observations were conducted at four selected locations within Universitas Teknologi Sumbawa. Each location was measured over a 10-minute interval and subsequently analyzed using the Equivalent Continuous Sound Level parameter for a 10-minute duration, referred to as Leq Time Measurement 10 minutes (LTM_{10}). The LTM_{10} approach was employed because it is capable of representing the dynamic variation of campus environmental noise within a short time frame relevant to daily academic activities.

Based on the Decree of the Minister of Environment No. 48 of 1996, the noise threshold for outdoor educational areas is set at 55 dB(A), while the noise exposure limit for 16-hour occupational exposure is 82 dB(A). The LTM_{10} values obtained at each measurement point are presented in Table 3.

Table 3. LTM_{10} Measurement Results at Each Location

Measurement Location	Measurement Time	LTM_{10} Value (dB(A))	Status Relative to Threshold (55 dB)
In Front of UTS Rectorate Building (Main Entrance)	08:30–08:40	61.20	Exceeds educational threshold (55 dB), still below occupational limit (82 dB)
FTLM Roundabout	09:15–09:25	57.50	Exceeds educational threshold (55 dB), still below occupational limit (82 dB)
Integrated Lab (ITL) Intersection	09:50–10:00	77.54	Exceeds educational threshold (55 dB), approaching occupational limit (82 dB)
SIKIM Intersection (Side Entrance of UTS)	10:20–10:30	59.54	Exceeds educational threshold (55 dB), still below occupational limit (82 dB)

Source: Primary field measurements using Class 2 Sound Level Meter processed by the authors.

The measurement results indicate that noise levels within the campus environment are not homogeneous but vary across locations. These variations are influenced by differences in human activity intensity, vehicle traffic volume, and the physical characteristics of open spaces surrounding each observation point. All measurements were conducted using a Sound Level Meter (SLM) with the same observation duration, allowing direct comparison of LTM_{10} values across locations. In general, LTM_{10} values ranged between 57–77 dB(A). The location with the highest noise level was the Integrated Lab (ITL) intersection, with a value of 77.54 dB(A), while the lowest noise level was recorded at the Faculty of Environmental and Mineral Technology (FTLM) roundabout at 57.50 dB(A). All values were subsequently evaluated against national noise threshold standards. These findings indicate that campus activity patterns and spatial characteristics play a significant role in shaping environmental acoustic conditions.

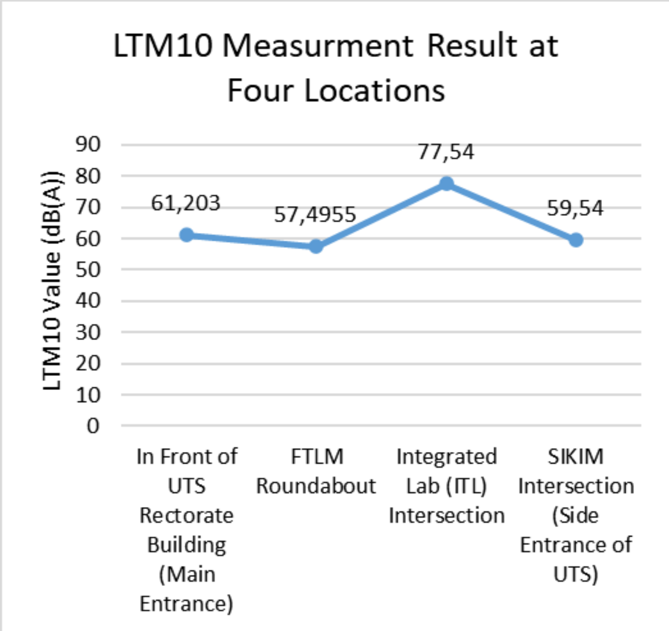

Figure 3. LTM_{10} Measurement Results at Four Locations

Furthermore, environmental noise levels exceeding 55 dB(A) have been reported to interfere with speech communication, concentration, and cognitive performance in educational environments. The World Health Organization (2018) states that prolonged exposure to environmental noise above recommended limits may reduce learning efficiency and increase annoyance levels (WHO, 2018). Similarly, Minichilli et al. (2018) found that road traffic noise exposure was associated with decreased academic performance among students. Therefore, although the measured values remain below occupational exposure limits, they may still affect academic comfort and performance (Minichilli et al., 2018).

Comparable noise ranges (60–75 dB(A)) have also been documented in university campuses located near traffic corridors and semi-urban environments. Muzzamil Yasin Peer et al. (2022) reported that campus noise levels frequently exceeded recommended educational standards due to internal traffic and surrounding road activity(Peer et al., 2025). Likewise, Akintunde et al. (2022) highlighted that spatial configuration and traffic density significantly influence campus acoustic environments(Akintunde et al., 2022). This comparison suggests that the noise condition at Universitas Teknologi Sumbawa reflects patterns commonly observed in similar higher education institutions.

3.1. Analysis of Each Measurement Point

3.1.1. In Front of the Universitas Teknologi Sumbawa Rectorate Building (61.20 dB(A))

The measurement location in front of the Rectorate Building represents the main campus access area, traversed by motor vehicles and serving as the center of administrative activities. The recorded noise level of 61.20 dB(A) indicates that the acoustic condition at this location falls within a low to moderate range. Although this measured noise level remains below occupational exposure limits, it exceeds the environmental noise threshold for educational areas and may reduce acoustic comfort during academic and administrative activities. The relatively low noise level in this area is influenced by several factors, including reduced vehicle speed due to its function as a campus entrance zone, traffic flow that is not continuous, and the presence of surrounding buildings that act as physical barriers to sound propagation. However, increased vehicle activity during certain periods may elevate noise levels; therefore, periodic monitoring is necessary.

Figure 4. Data Collection at Measurement Point 1

3.1.2. Faculty of Environmental and Mineral Technology (FTLM) Roundabout (57.50 dB(A))

The FTLM roundabout exhibited the lowest noise level compared to other locations. This condition reflects a relatively quiet environment that supports academic activities such as lectures, discussions, and research. The lower noise level is influenced by minimal vehicle traffic, the location's distance from the main campus roadway, and the presence of vegetation that functions as a natural sound barrier. Although the noise level at this location slightly exceeds the educational area threshold, the overall acoustic quality remains better compared to other measurement points. Although this location recorded the lowest noise level among all observation points, the measured value still slightly exceeded the environmental noise threshold for educational areas.

Figure 5. Data Collection at Measurement Point 2

3.1.3. Integrated Lab (ITL) Intersection (77.54 dB(A))

The Integrated Lab intersection recorded the highest noise level among all locations. The LTM_{10} value of 77.54 dB(A) indicates that this area experiences relatively high acoustic pressure, approaching the occupational exposure limit. The elevated noise level is influenced by its proximity to the main campus roadway, high vehicle traffic volume, and relatively higher vehicle speeds compared to other locations. Additionally, the limited presence of natural noise-reducing elements such as vegetation or sound barriers allows sound waves to propagate directly without significant attenuation. Although the value remains below the occupational threshold limit, this condition may potentially disrupt student concentration and laboratory activities, particularly during peak hours. Therefore, this area should be prioritized in campus noise control planning.

Figure 6. Data Collection at Measurement Point 3

3.1.4. SIKIM Intersection (59.54 dB(A))

The noise level at the SIKIM intersection was recorded at 59.54 dB(A), categorized as low to moderate. This level is influenced by vehicle and student activities that occur steadily but are not overly dense. The relatively enclosed physical configuration of the area, surrounded by buildings, creates a sound reflection effect while simultaneously acting as a barrier that limits noise propagation to adjacent areas. Overall, although the measured noise level remains below occupational exposure limits, it still exceeds the recommended environmental comfort threshold for educational environments. However, changes in activity patterns in the future may increase noise levels, and therefore continuous monitoring is still required.

Figure 7. Data Collection at Measurement Point 4

3.2. Analysis of LTM_{10} Compliance with Noise Threshold Limits

The evaluation of noise compliance was conducted by comparing the measured LTM_{10} values with the Noise Threshold Limits stipulated in the Decree of the Minister of Environment No. 48 of 1996. For outdoor educational areas, the noise limit is set at 55 dB(A), while for 16-hour occupational exposure, the limit is 82 dB(A).

The results indicate that several measurement points exceeded the recommended environmental comfort limit for educational settings (55 dB(A)). However, all recorded LTM_{10} values remain below the occupational exposure threshold of 82 dB(A). From a regulatory perspective, this indicates that the measured noise levels do not exceed occupational exposure limits under the observed measurement duration within typical campus activity durations.

Nevertheless, compliance with occupational limits does not necessarily imply the absence of functional or cognitive impacts. Recent scientific evidence demonstrates that environmental noise exposure even at moderate levels below occupational thresholds can adversely affect cognitive performance and academic productivity. A systematic review by Zhou et al. (2024) reported that moderate broadband noise exposure (<85 dB(A)) may negatively influence attention, memory, and task performance depending on task complexity and exposure duration(Zhou et al., 2024). Similarly, Dohmen et al. (2022) highlighted that environmental noise can interfere with cognitive processing, emotional regulation, and motivation, thereby reducing overall task efficiency in learning environments(Dohmen et al., 2023).

Furthermore, experimental findings indicate that noise interference is associated with increased reaction time and decreased concentration during cognitively demanding tasks (Chander et al., 2023). A recent meta-analysis also confirms that chronic exposure to environmental noise is significantly correlated with reduced cognitive performance, particularly in attention and memory domains relevant to academic activities(Fernández-Quezada et al., 2025). These findings suggest that although the measured LTM_{10} values comply with occupational safety standards, noise levels exceeding 55 dB(A) may still compromise learning comfort and cognitive effectiveness within the campus environment.

Therefore, the evaluation of LTM_{10} compliance should not only consider regulatory occupational thresholds but also educational environmental quality standards. Preventive noise mitigation strategies such as traffic flow management, vehicle speed regulation, installation of vegetative sound barriers, and periodic acoustic monitoring are recommended to enhance academic comfort and maintain an optimal learning atmosphere.

3.3. Study Limitations

This study has several limitations that should be considered when interpreting the findings. First, the environmental noise measurements were conducted within a limited observation period using the LTM10 approach at specific morning-time intervals, which may not fully represent daily temporal variations in campus noise exposure. Noise levels in university environments may vary significantly during different activity periods such as afternoon peak hours, evening activities, or special campus events. Second, the number of measurement locations was restricted to four representative observation points selected based on activity intensity and spatial characteristics. Although these locations reflect major mobility zones within the campus area, additional measurement points could provide a more comprehensive spatial representation of environmental noise distribution.

Third, this study focused primarily on short-term equivalent noise level assessment and did not include long-term monitoring or frequency spectrum analysis that could further explain acoustic characteristics and source-specific contributions. Fourth, the measurements were conducted using a Class 2 Sound Level Meter under field conditions, which may introduce minor uncertainties related to environmental influences such as wind conditions, surrounding reflective surfaces, and short-term fluctuations in traffic activity during the observation period.

Finally, the findings of this study are specific to the spatial characteristics and activity patterns of the Sumbawa University of Technology campus; therefore, caution should be exercised when generalizing the results to other university environments with different layouts, traffic intensities, or surrounding land-use conditions. Therefore, future studies are recommended to incorporate extended monitoring durations, additional observation points, multi-period measurements, and complementary acoustic indicators to obtain a more comprehensive environmental noise profile within university campus environments.

4. CONCLUSION

Based on the results of environmental noise measurements conducted at Sumbawa University of Technology using the 10-minute equivalent continuous sound level approach (LTM_{10}), it can be concluded that noise conditions at the four observation locations vary depending on activity intensity, traffic volume, and the physical and spatial characteristics of each area. The recorded LTM_{10} values ranged from 57.50 to 77.54 dB(A), with the highest noise level identified at the Integrated Laboratory (ITL) intersection area, while the lowest level was recorded at the Faculty of Environmental and Mineral Technology (FTLM) roundabout.

The evaluation results indicate that all measured noise levels exceeded the recommended environmental noise limit for outdoor educational areas, namely 55 dB(A), as stipulated in the Decree of the Minister of Environment No. 48 of 1996 concerning Noise Level Standards. This condition suggests that acoustically, the campus environment has not fully met the ideal comfort criteria required to optimally support academic activities. At the international level, guidelines issued by the World Health Organization (WHO,2018) also emphasize that environmental noise exposure above 55 dB(A) may lead to reduced concentration, psychological stress, and decreased learning performance over time.

However, all LTM_{10} values remain below the maximum occupational noise exposure limit of 82 dB(A). Therefore, from an occupational health perspective, the measured noise levels are not classified as high-risk for noise-induced hearing loss. Nevertheless, recent studies indicate that moderate noise exposure levels (below 85 dB(A)) can still negatively affect cognitive performance, attention, and mental task efficiency, particularly in educational environments. Consequently, noise assessment in campus areas should not only consider occupational safety thresholds but also account for acoustic comfort and learning effectiveness.

The Integrated Laboratory (ITL) intersection area, with an LTM_{10} value of 77.54 dB(A), can be categorized as the location with the most significant noise exposure and the closest to the occupational threshold limit. Therefore, this area should be prioritized in campus noise management efforts through preventive measures such as internal traffic control, vehicle speed restrictions, optimization of vegetative elements as natural sound barriers, and noise-mitigated spatial planning. These measures align with sustainable environmental management principles that emphasize preventive risk control before adverse health and academic impacts occur.

Overall, this study provides empirical evidence regarding the actual noise conditions within the Sumbawa University of Technology campus and serves as a scientific reference for data-driven campus noise management policies. Future research with longer measurement durations and time variations (morning, afternoon, and evening) is recommended to obtain a more comprehensive representation of daily noise profiles.

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REFERENCES

Adi Rahayu, S., Khair AM, H., Nurfahasdi, M., & Novita Nainggolan, I. (2024). Analisis dan Pemetaan Tingkat

Kebisingan di Kawasan Kampus Universitas Sumatera Utara. *Dampak*, *21*(2), 41–48. https://doi.org/10.25077/dampak.21.2.41-48.2024

Akintunde, E. A., Bayei, J. Y., & Akintunde, J. A. (2022). Noise level mapping in University of Jos, Nigeria. *GeoJournal*, *87*(4), 2441–2453. https://doi.org/10.1007/s10708-019-10135-w

Aletta, F., Oberman, T., & Kang, J. (2018). Positive health-related effects of perceiving urban soundscapes: a systematic review. *The Lancet*, *392*(740696), S3. https://doi.org/10.1016/s0140-6736(18)32044-0

Basner, M., & MDWolfgang Babisch, P. (2014). Auditory and non-auditory effects of noise on health NIH Public Access. *NIH Public Access Author Manuscrip*, *23*(1), 1–7. https://doi.org/10.1016/S0140-6736(13)61613-X.Auditory

Benafa, D., Adelia, K. A. C., Uskenat, K., & Baimau, Y. (2024). Analisis Tingkat Kebisingan di Lingkungan Universitas San Pedro Kupang. *Magnetic: Research Journal of Physics and It's Application*, *3*(2), 239–243. https://doi.org/10.59632/magnetic.v3i2.380

Chander, H., McCrory, A., Chandler, S. J., Freeny, S., Griffith, A., Burch, R., Strawderman, L., & Knight, A. C. (2023). Noise Interference Impacts Simple and Choice Response Times during a Lower Extremity Cognitive–Motor Task. *Clinical and Translational Neuroscience*, *7*(1), 4. https://doi.org/10.3390/ctn7010004

Clark, C., & Paunovic, K. (2018). WHO environmental noise guidelines for the european region: A systematic review on environmental noise and cognition. *International Journal of Environmental Research and Public Health*, *15*(2). https://doi.org/10.3390/ijerph15020285

Dohmen, M., Braat-Eggen, E., Kemperman, A., & Hornikx, M. (2023). The Effects of Noise on Cognitive Performance and Helplessness in Childhood: A Review. *International Journal of Environmental Research and Public Health*, *20*(1). https://doi.org/10.3390/ijerph20010288

Fernández-Quezada, D., Martínez-Fernández, D. E., Fuentes, I., García-Estrada, J., & Luquin, S. (2025). The Influence of Noise Exposure on Cognitive Function in Children and Adolescents: A Meta-Analysis. *NeuroSci*, *6*(1), 22. https://doi.org/10.3390/neurosci6010022

Fredianelli, L., Lercher, P., & Licitra, G. (2022). New Indicators for the Assessment and Prevention of Noise Nuisance. *International Journal of Environmental Research and Public Health*, *19*(19). https://doi.org/10.3390/ijerph191912724

Garg, N., Kumar, S., Gautam, C., Gandhi, V., & Gupta, N. K. (2023). Evaluation and Analysis of Long-term Environmental Noise Levels in 7 Major Cities of India. *Archives of Acoustics*, *48*(1), 103–126. https://doi.org/10.24425/aoa.2023.144265

Huang, X., Liu, J., & Meng, Z. (2022). Application of University Campus Noise Map Based on Noise Propagation Model: A Case in Guangxi University. *Sustainability (Switzerland)*, *14*(14). https://doi.org/10.3390/su14148613

Mealings, K., Miles, K., Matthews, N., & Buchholz, J. M. (2024). Towards an Acoustically Accessible Campus: A Case Study of the Acoustic Conditions of an Australian University. *Acoustics Australia*, *52*(2), 273–278. https://doi.org/10.1007/s40857-024-00323-1

Minichilli, F., Gorini, F., Ascari, E., Bianchi, F., Coi, A., Fredianelli, L., Licitra, G., Manzoli, F., Mezzasalma, L., & Cori, L. (2018). Annoyance judgment and measurements of environmental noise: A focus on italian secondary schools. *International Journal of Environmental Research and Public Health*, *15*(2), 1–17. https://doi.org/10.3390/ijerph15020208

Ministry of Environment of the Republic of Indonesia. (1996). *Decree of the Minister of Environment No. KEP-48/MENLH/11/1996 concerning Environmental Noise Level Standards.*

Peer, M. Y., Mir, M. S., & Mohanty, B. (2025). Evaluation of the spatiotemporal variations of road traffic noise pollution and public cognizance of associated health hazards within urban environments. *International Journal of Sustainable Transportation*, *19*(10), 923–943. https://doi.org/10.1080/15568318.2025.2526788

Prahmani, Y. S., Chasanah, A. N., Maharani, S. A., Hidayah, H. S. N., Rabbani, R. R., Fariz, T. R., Jabbar, A., Deanova, D., & Addini, J. T. (2024). Hubungan Volume Kendaraan Terhadap Tingkat Kebisingan Lalu Lintas Di Universitas Negeri Semarang. *Lingkar: Journal of Environmental Engineering*, *4*(2), 13–23. https://doi.org/10.22373/ljee.v4i2.4158

Stansfeld, S., & Clark, C. (2015). Health Effects of Noise Exposure in Children. *Current Environmental Health Reports*, *2*, 171–178. https://doi.org/10.1007/s40572-015-0044-1

World Health Organization. (2018). *World Health Organization, 2022. Compendium of WHO and other UN guidance on health and environment. Environmental noise*. *WHO/HEP/EC*, 1–6. https://cdn.who.int/media/docs/default-source/who-compendium-on-health-and-environment/who_compendium_noise_01042022.pdf?sfvrsn=bc371498_3

Yalili Kilic, M., & Abus, M. N. (2020). Determination of noise pollution in the hudavendigar urban park of Bursa, Turkey. *Applied Ecology and Environmental Research*, *18*(2), 2073–2085. https://doi.org/10.15666/aeer/1802_20732085

Zaffaroni-Caorsi, V., Azzimonti, O., Potenza, A., Angelini, F., Grecchi, I., Brambilla, G., Guagliumi, G., Daconto, L., Benocci, R., & Zambon, G. (2025). Exploring the Soundscape in a University Campus: Students' Perceptions and Eco-Acoustic Indices. *Sustainability (Switzerland)*, *17*(8), 1–20. https://doi.org/10.3390/su17083526

Zhou, H., Molesworth, B. R. C., Burgess, M., & Hatfield, J. (2024). The effect of moderate broadband noise on cognitive performance: a systematic review. In *Cognition, Technology and Work* (Vol. 26, Issue 1). Springer London. https://doi.org/10.1007/s10111-023-00746-2