

Level of Traffic Noise Annoyances Based on Subjective Approaches

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Abstract

Annoyance and comfort human in carrying out an activity is not only influenced by internal factors, but also by external factors namely condition of the surrounding environment including the influence of traffic noise. Noise limit that can be accepted by humans have been set in accordance with their designation by State Minister for The Environment of Republic Indonesia. But on the other hand humans have different levels of acceptance. The purpose of this study was to analyze the level of student annoyance to the level of traffic noise. The research method uses a subjective approach based on individual perceptions of a number of students. Noise measurement using a Sound Level Meter (SLM). The results showed that the perception of the level of student annoyance to traffic noise is not disturbed by 30%, rather disturbed 41%, disturbed 8%, simply disturbed 19%, and very disturbed 2%. Subjectively, it was found that variations in individual annoyance of students were annoyance level 1 (not disturbed) at the level 54.7 dB, annoyance level 2 (rather disturbed) at level 61.3 dB, annoyance level 3 (disturbed) at the level 65.4 dB, annoyance level 4 (simply disturbed) at the level 68.6 dB, and annoyance level 5 (very disturbed) at the level 71.1 dB.

Keywords: Annoyance, noise, subjective, traffic

I. INTRODUCTION

Traffic noise is a strategic issue that is currently a problem in urban areas throughout the world including Indonesia. The increasing number of vehicles is in line with the increasing level of traffic noise. The higher the number of motor vehicle users in urban areas will cause traffic noise to increase as well. Therefore, the intensity of vehicles passing on the highway in urban areas will have an impact on increasing environmental noise around the road. Annoyance and comfort human in carrying out an activity is not only influenced by internal factors, but also by external factors, namely the condition of surrounding environment including the influence of traffic noise. One of the land uses that requires a quiet environment from traffic noise is the education zone. Noise exposure in individual students who are learning can result in decreased learning performance, especially impaired concentration while reading. It was found that the physiological and psychological effects of noise i.e. headache, disturbs their peace of mind, nervousness, stressful, speech interference and insomnia [1].

Noise is an unwanted sound at a certain level and time that can cause human health disorders and environmental comfort. High traffic noise and in a long time will cause discomfort in the surrounding environment. Adverse effects for someone who is exposed to noise, such as physiological disorders, communicating disorders, and deafness. The noise level that can be received by someone depends on what activities carried out by the person. Traffic noise is the main source of environmental annoyance [2].

According to the result of the study that the average noise level on the highway in the Kendari city has reached 75.5 dB for arterial roads and 73.4 dB for collector roads [3]. Although objectively based on the Decree of the State Minister of Environment of the Republic of Indonesia has exceeded the threshold, however subjectively each individual has a different level of annoyance to noise. For example, people who live in the area of electricity generation (PLN) will have different levels of annoyance with people in other urban areas. Likewise with students in schools as well as hospital patients, subjectively different levels of annoyance. Heavy vehicles with a composition of 4% greatly affect traffic noise on the highway. while the composition of 3% is not significant to the noise level [4].

II. MATERIAL AND METHODS

Traffic noise is a potential health hazard and an unjustifiable disturbance to human comfort. There is a relationship between traffic noise and annoyance in the daily life of the community on the side of the road, including employees in offices, banks, etc [5]. The high-income people will experience a higher level of annoyance to traffic noise than low-income people [6]. Continual exposure to traffic noise on the road to humans can cause various types of discomfort. However, there will be difficulties when non-acoustic factors such as sensitivity, socio-economic and age are taken into account together with acoustic factors [7].

Threshold value (NAB) or noise level standard is the maximum limit of noise level that is allowed to be discharged into the environment from an activity so that it does not cause annoyance to human health and environmental comfort [8]. The noise quality standards applicable in Indonesia refer to the Decree of the State Minister of Environment as shown in Table 1.

Table 1. Quality Standards of Noise Level

Description	Noise Level dB(A)
a. Appropriation of region	
1. Housing and Settlements	55
2. Trade and Services	70
3. Office and Commerce	65
4. Green open space	50
5. Industry	70
6. Government and Public Facilities	60
7. Recreation	70
8. Specifically:	
- airport *	
- Railway station *	
- harbor	70
- Cultural heritage	60
b. Surrounding Activity	
1. Hospital or the like	55
2. School or the like	55
3. Worship place or the like	55

Several studies conducted in many countries show that roads are the main source of noise in cities. This is due to the high usage of motorized vehicles compared to other types of vehicles, both two-wheeled, four-wheeled, and more than four-wheeled. Heavy vehicles (trucks, buses) and passenger cars are the main sources of noise on the road even though the composition of the motorcycle is more dominant at 60% [9]. Among various modes of transportation, motor vehicle noise on the road is more disturbing than noise from trains. But on the other hand actually found that train noise is the most prominent source of noise from various noise disturbances [10]. It is recommended that the noise disturbance model be from a combined source (aircraft, road traffic and rail noise) [11].

Research in Belgrade municipality found that road traffic noise at night is the most disturbing noise of city residents. So he suggested using nighttime noise levels as an indicator of exposure to noise disturbance assessments [12]. In general, humans can be disturbed because of traffic noise, both at high and lower noise levels [13].

There are also studies that compare the data by providing a disturbance scale ranging from 0 to 100. Percentage limits are "disturbed" by 50% and "severely disturbed" 72% [14]. Determination of the relationship between two variables must use a statistical approach. One method of testing between two or more variables is the Spearman Rank correlation test. As for interpreting the relationship between two variables, values are used as shown in table 2.

Table 2. Interpretation of Correlation

Coefficient interval	Interpretation
0.00 – 0.199	Very Low
0.20 – 0.399	Low
0.40 – 0.599	Moderate
0.60 – 0.799	Strong
0.80 – 1.000	Very Strong

Table-3. Student Population

No	Description	Gender	Number	Total
1	Class VII	Male	122	255
		Female	133	
2	Class VIII	Male	156	294
		Female	138	
3	Class IX	Male	181	344
		Female	163	
Total Number				893

The population in this study were 893 school students. Based on the results of the analysis using the Slovin equation, then from 893 student populations, there were 90 research samples. The sample selection technique uses the Random Sampling method by randomizing numbers using the Smartphone application, then matching it to the student seat sequence number. While the scoring method uses a numerical scale as shown in Figure 1.

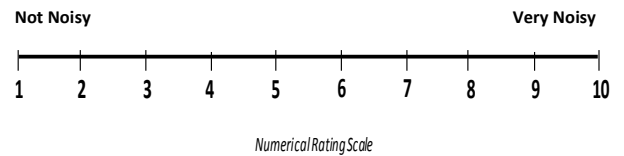


Fig. 1 Numeric Scale

III. RESULTS AND DISCUSSION

Equivalent continuous noise level (L_{eq}) is a parameter in determining the level of environmental noise due to motorized vehicle traffic on a highway. Because the resulting sound fluctuates, then the statistical calculation of noise number at each sample point uses a simple statistical method. In Figure 2 it can be seen that the highest frequency of occurrence of noise occurs at 79 - 81dB level of 18.3%.

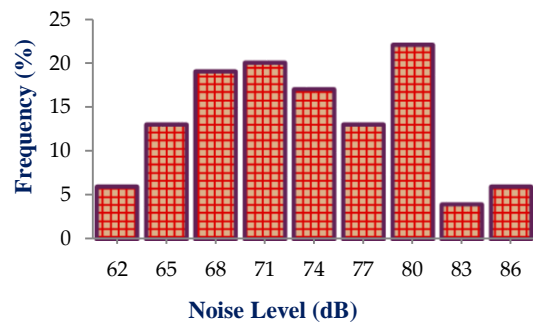


Fig. 2 Frequency of Noise Value

Based on the noise measurement data obtain by the noise level. Furthermore based on the results of noise analysis L_{eq} values obtained as shown in Figure 3.

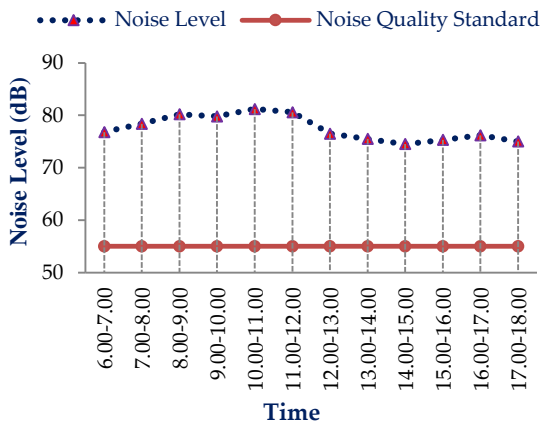


Fig. 3 Noise Level Fluctuations

Figure 3 shows that the traffic noise level has exceeded the environmental threshold in accordance with the Decree of the Minister of Environment of the Republic of Indonesia for the school area which is 55 dB [5]. Where the highest noise level at the study location was 85.3 dB and the lowest was 72.1 dB. The average noise level is 78.7 dB. To find out the relationship between the level of annoyance and noise level, first we must get the noise level in the classroom. The following are the steps to predict noise level in class IX D and IX E:

- Class distance IX D and IX E is 22.6 m from the edge of the road
 - SLM measurement distance of 1.7 m from the edge of the road
 - The average Leq for 2 days of measurement was 77.5 dB. Thus, L_{eq} class IX DE = $77.5 - 10\log(22.6/1.7) = 66.3$ dB
- In the same way a prediction of noise level is obtained for each classroom as shown in Table 4.

Table 4. Noise Prediction in Classrooms

Classroom	Distance (m)	Noise Level (dB)
IX D, IX E	22.6	66.3
IX A, IX B, IX C	27.6	65.4
VII A, VII H, VII I, IX F, IX G	41.6	63.6
VII B	46.6	63.1
VII F, VII G, VII J	53.4	62.4
VII C, VII D, VII E	54.6	62.5
IX H	103.9	59.6
IX I	112.9	59.3

Based on the data in Table 4, there is a relationship between the level of annoyance and noise level as well as with other variables.

Table 5. Correlation Test

	JK	AGE	LMT	LNT	LEQ	TND
Spearman's rho	-0.009	0.030	0.129	0.227	0.617**	-0.238
TKG	0.957	0.848	.416	.149	0.000	0.129
Coefisien Correlation Sig. (2-tailed)						
N	42	42	42	42	42	42

In Table 5 it can be seen that the noise level has a strong positive relationship with the level of individual student annoyance of 0.617 with a confidence level of 99%. If probability > 0.025 then H_0 is accepted and if probability < 0.025, then H_0 is rejected. The analysis shows that the significance between the noise level (Leq) and the annoyance level is 0,000 or the probability < 0.025. Then H_0 is rejected, meaning that the noise level has a significant effect on the level of student annoyance.

Based on the analysis obtained a regression equation to find the value of the dependent variable based on independent variable value. in this study the dependent variable is annoyance level and the independent variable is the level of noise in the classroom.

Table 6. Level of Annoyance

Level	L_{eq} (dB)	Description
1	54.7	Not Distrubed
2	61.3	Rather Disturbed
3	65.4	Disturbed
4	68.6	Simply Disturbed
5	71.1	Very Disturbed

Although objectively the noise level has exceeded the environmental quality standard. but subjectively, it is not necessarily disturbing individuals. The results study get individual student noise disturbance scale which can be used as a reference comparison of noise disturbance based on standard noise values. Objectively, determined that the noise limit can be allowed for the school area is 55 dB, but it is subjectively found that school students feel disturbed precisely at the level of 65.4 dB. This means in determining noise interference not only based on objective noise according to the measurement results but can also be considered from the individual's subjective aspects.

IV. CONCLUSION

Perception of the level of student annoyance to traffic noise is not disturbed by 30%, rather disturbed 41%, disturbed 8%, simply disturbed 19%, and very disturbed 2%. Subjectively, it was found that variations in individual annoyance of students were annoyance level 1 (not disturbed) at the level 54.7 dB, annoyance level 2 (rather disturbed) at level 61.3 dB, annoyance level 3 (disturbed) at the level 65.4 dB, annoyance level 4 (simply disturbed) at the level 68.6 dB, and annoyance level 5 (very disturbed) at the level 71.1 dB.

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