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Effects of Classroom Noise on Teaching and Learning of High School Students in Jakarta

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Abstract: ***This study concerns classroom noise of high school in Jakarta, Indonesia. Goals of this study are to investigate sources of school noise, effects of noise on teaching and learning of high school students, determine the relationship between noise levels and degree of annoyance. and experiments to reduce school noise levels. 120 students, between ages 19–22 years took part in study. Noise measurements, questionnaire, and experiments for restrictions of noise levels were carried out. Measured noise levels LAeq were ranged between 61.3 and 73.2 dB. There was strong relationship between noise levels and percentage of highly annoyed respondents. Analysis of the responses to the questionnaire found that 57% of respondents said that noise obstructed their learning achievement. Respondents said that road traffic, railway noise, chatter in class room and scraping sounds from tables and chairs were the most annoying sources.Results of restrictions to improve environmental conditions found that, in absence of road traffic noise, maximum reductions LAeq were 12.4 dB. Absence of railway noise, LAeq was decreased 11.3 dB. Absence of chatter in class room and scraping sounds from tables and chairs LAeq was decreased 8.2 dB. This shows that town planner can use various strategies to change school noise composition in order to achieve quieter environments at schools.***

Keywords: classroom noise, teaching and learning, annoyance

1. Background

Noise is the most persistent physical contaminant in human. It can cause a series of detrimental health effects on human beings, such as Hearing Loss, Annoyance, Cardiovascular Disease, Sleep Disturbance, Immune Effects, Biochemical Effects, Reproductive Effects and Performance Effects, among which the best studied effect produced by the overexposure to noise is loss of hearing (Fernandez et al 2009). The importance of room acoustics for working conditions is shown by data from research n different acoustic conditions in classroom can be interpreted as interaction between stress situation and behavior. In opposite "very good" acoustic working conditions reduces stress and give high concentration over all lessons.

In the learning context, noise affects the behavior and understanding of students, and very noisy places are unfavorable for learning and make teaching exhaustive (Hagen et al2002). Poor acoustical condition and high noise levels can cause many problems for the instructors and students. Besides the risk of hearing damage, noise may cause on memory, performance, headache, increase blood pressure, and disturbance with activities [2–4].High sound levels not only affect the verbal quality of communication but also contribute to serious problems in the intellectual development of students, such as impaired learning, writing and speaking difficulties, limitations in reading comprehension and development of vocabulary (Berglund et al, 1990).

Noise exposure problems vary in different school environments due to the presence of different noise sources as well as due to the variety of activities being carried out in these environments. Sayed(2013) studies sources of school noise andeffects of noise on learning achievement students in Assiut, Egypt. A number of findings have indicated that 57% of respondents said that noise obstructed their learning achievement. Respondents said that road traffic, railway noise, chatter in class room and scraping sounds from tables and chairs were the most annoying sources.Results of restrictions to improve environmental conditions found that, in absence of road traffic noise, maximum reductions LAeq were 12.4 dB. Absence of railway noise, LAeq was decreased 11.3 dB. Absence of chatter in class room and scraping sounds from tables and chairs LAeq was decreased 8.2 dB.

Recently, research in the acoustic field was focused on listening quality and on noise effects in learning environments (Prodi et al , 2013, Astolfi et 2102). A good acoustic environment is primarily achieved by the minimization of the contributions of noise from external (e.g. traffic) and from internal (e.g. HVAC systems, chatting) sources. In addition, good communication is ensured when room acoustics and intelligibility parameters are in the acceptable ranges for teaching and learning purposes (DIN 2004, Pelegrin et al, 2012).

Several studies have demonstrated that specific unidimensional acoustical measures of voice strongly correlate with depression scores derived from clinical rating scales.22. Recent studies have produced preliminary evidence that acoustic measures are effective in discriminating between depressive states, including dysthymia, major depression, and high-risk suicidal states.

The results of Kiri () study suggest that open plan classrooms with over 90 students are not appropriate learning environments for young children due to the high intrusive noise levels experienced in these types of spaces. These noise levels are likely to affect not only the children‟s learning, but also cause vocal health problems for the teachers from the need to constantly raise their voice above a comfortable level to be heard. These findings suggest that while a classroom with four solid fully enclosed walls is likely to be the best learning environment, a single classroom with a concertina wall should provide adequate listening conditions most of the time. This type of classroom

also gives the flexibility of opening the concertina wall for the activities the teachers prefer to have a more open plan space for, but then closing it for critical listening activities to minimize intrusive noise and enhance speech perception.

A key study relating to this research was conducted by Shield and Dockrell (2008), to examine the impact of external and internal noise on the academic attainments of London primary school children, although it only considered a number of schools situated in 3 London boroughs. It was found that external noise has a significant negative impact upon performance, the effect being greater for the older children. Hui et al (2011) investigate the relationshSS between environmental noise levels of secondary schools in Greater London and academic achievement factors. It has been shown that the environmental noise levels of secondary schools in Greater London have almost no significant relationshSS with those academic achievement indicators. As expected, the secondary schools in Inner London are noisier than those in Outer London.
Goran et al (2012) was study to examine the relationshSS between noise and school children‟s executive functioning (EF), includes decision making, working memory, and self-regulation of emotions and behaviors. The study included 311 children (146 boys and 165 girls) aged 7e11 years, who lived in the center of Belgrade There were no significant main effects of ambient noise levels on EF, however, a significant interaction indicated adverse noise impacts on boy‟s.The aim of this study is to investigate the sources of school noise, impact of classroom noise on teaching and learning, determine the relationship between noise levels and degree of annoyance, and to carry out experiments to reduce school noise levels.

2. Materials and methods

The study was carried out in two public schools in central Jakarta between September 2013 and March 2014.

Measurements sound level
A weighted equivalent sound pressure levels (Leq) and were expressed in dB were measured with an integrating sound level meter Bruel & Kjaer type 2230. The meter was placed at a position in the middle of the group corresponding to the ear height of the students. Sound level measurements were made for 20 min in middle of a lesson for each class. The first and last 10 min of the lesson were excluded because of the start up and ending procedure of the lesson. On measurement occasion students were seated in a class room working on physics. The noise measurements were compared with the limit recommended by WHO for educational areas – Leq = 55 dB(A) . Acoustic descriptors such as

Noiseand annoyance in the classroom
The survey was carried out simultaneously with measurements at the same sites (6 classes in two schools), each site exposures to some kinds of sources of noise, and representing all measured noise levels. The students were asked sources of school noise, effect of noise on concentration, lesson, performance and other activities.in a multiple choice question, psychological and physiological effects, reactions against noise, agencies should control school noise, suggest maximum sound levels for good teaching and learning and performance. The questionnaire was distributed by hand. The respondents completed the questionnaire themselves. A total of 130 questionnaires for students (95 for girls and 80 for boys, male teacher 12 and female teacher 26) were distributed and 87 questionnaires were completed correctly (86 girls, 71 boys, female teacher 26, male teacher 10).

3. Results and Discussion

3.1 Distribution of potential determinants of noise disturbance

Table 1 presents gender and health for the total group of respondents. The majority of the respondents (83%) reported their health very good. And 42% reported their health to be good). In classroom classified NS1, NS2, NS3, SS1, SS2 and SS3

Table 1 Characteristics of the respondents and distribution between schools characterized by short reverberation time (RT), medium RT and long RT in the classrooms

Responden	NS1	NS2	NS3	SS1	SS2	SS3
Boys	13	14	14	13	13	13
Girl	15	16	16	17	16	15
Female teacher	4	4	5	5	4	4
Male teacher	3	2	1	2	2	2
Very good health(%)	81	82	80	83	83	85
Fair good health(%)	32	36	41	42	38	41
less good health (%)	2	1	3	1	1	2
Current smoker(%	1	-	-	2	-	-
Former smoker(%)	2	1	-	1	-	1
Have never smoked(%)	65	53	44	44	74	63

(NS = natural science program, SS = soscial science program)

The number of children in the class was significantly associated with self-reported noise exposure, however, not in a strict dosedependent way. The deviation from a dosee response trend might be due to the relatively low number of responses related to large classes (54 responses) compared to small and medium sized classes (124 and 102 responses, respectively). It is also conceivable that awareness of noise problems is higher in large classes, which paradoxically might reduce the problem. That the size of the class could be an important determinant of noise problems is supported by the observation of significant correlation between measured classroom sound levels and the number of children in London schools (Shield & Dockrell, 2004).

3.2 Noise of measurement

Measurements were carried out for 10 and 20 min. Levels were measured each 5 min in mentioned time. LAeq 20 min was calculated for the 6 different classes by using the following equation

$$LAeq\ 20\ min = 10\log 10 \sum_{}^{n} 100^{Laeq/10}$$

where n is the number of 5 min measurements.

Results showed that all LAeq 1 min were ranged between 56.0 and 65.4 dB (higher than 60 dB). Table1 shows measured school noise levels for selected classes in Jakarta.

Table 1: Comparison of measured classroom noise levels measured during 10 or 20 min

No	Measurement classroom	T = 10 min Leq dB(A)	T = 20 min Leq dB(A)
1	NS 1	56	55.7
2	NS2	59.7	60.1
3	NS3	61.5	63.7
4	SS 1	57.6	57.5
5	SS 2	62.3	65.7
6	SS3	56.7	56.2
7	Cantin	65.4	63.2
8	Coridor	60,4	61

A paired Student‟s t-test was performed in order to compare the noise levels measured in the 8 points for 10 and 20 min: levels were not different (P = 0.522).Thus, to save time and equipment, and assure constant meteorological conditions during measurements, 10 min measurement time was the procedure adopted here. Other studies about noise mapping found in the literature adopted measuring times of 3-60 min (Paulo et al, 2013).There are also studies such as that of Sayed. (2013), who state that a time of 5 min and 20 min sufficed to describe the noise events that required observation in their study.

By studying characteristics of school noise in public school Jakarta, we assumed that school noise levels were too high due to many reasons as: (i) noise emits from lorries, cas, buses, (ii) noise emits from banging on doors, bins clattering, and (iii) noise emits from chattering in classroom and scraping sounds from tables and chairs.

3.3 Results of survey of theannoyed by school noise

Results of survey annoyed by school noisewere as: 48% of the respondents who were annoyed declared themselves to be „highly annoyed‟, 28.2% „moderately annoyed‟, 14.6% „moderately annoyed‟, 11.4% „little annoyed‟

Table 2: Annoyed by school noise

No	annoyed by school noise	Number respondents(%)
1	highly annoyed	48.0
2	rather annoyed	28.2
3	moderately annoyed	14.6
4	little annoyed	11.4

Fig. 1 shows that there was a strong relationship between school noise levels and percentage of respondents who felt highly annoyed. The percentage of respondents who were highly annoyed increased with increasing school noise levels. More than 55% of respondents claimed that existing sound environment obstructed their concentration on learning their lessons and performance. No difference was found between physiscs students and chemistry students in rated annoyance and effect on their learning and performance. Girls students were more annoyed than boys dtudents

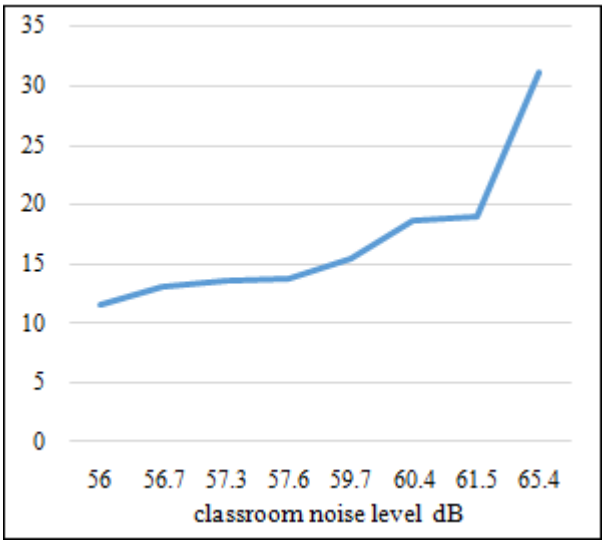

Figure 1: Relationship between classroom noise levels and percentage of respondents who felt highly annoyed

3.4 The Impact of Classroom noise on Teaching and Learning

Responses on the remaining subscales create a detailed impression of listening conditions and the impact of noisein classrooms. For example, the situations identified as being the hardest in which to hear the teacher were when “other students are talking in my classroom” (mean = 2.38, SD = 1.2) and “when other students are making a noise in nearby classrooms” (mean = 2.24, SD = 1.19). The highest rated responses to impact of noise in the classroom subscale n response to the prompt “When it‟s noisy or hard to hear in my classroom…” were “my concentration is easily broken” (mean = 3.24, SD = 1.32) and “I don‟t learn as much as in a quiet lesson” mean (mean =2.86, SD = 1.32). Lastly, the activities during which pupils reported being most sensitive to the disruptive effects of noise were while “…doing a test or exam” (mean = 3.44, SD = 1.46) and when reading (mean = 2.84, SD = 1.39).

57.2% of respondents said that by increasing school noise level leads to decreasing possibility to concentrate to their lessons, carry out conversation with their teacher and among each other during class, and performance. Table 2 shows the relationship between school noise levels and possibility to concentrate to their lessons and performance. At 63.7 dB of school noise levels, 10% of respondents said that they can concentrate to their lessons and performance. At 57.5 dB of school noise levels, 67% of respondents only said that they can concentrate to their lessons and performance. At 52.6 dB of school noise levels, 84% of respondents said that they can concentrate to their lessons and performance. This means by increasing school noise level possibility of students to concentrate to their lessons and performance were decreased.

Table 3: Relation school noise level and concentrate lessons

No	*noise level*	*students concentrate to their lessons(%)*
1	52.6	84
2	55.7	79
3	56.2	72
4	57.5	67
5	60.1	58
6	61.0	52
7	63.2	48
8	63.7	10

Related question, what the annoying sources of noise in your class? 72% of respondent said that main (arterial and collector) roads were one of annoying sources of noise in their classes. 56% of respondent said that chatter in class room and scraping sounds from tables and chairs were one of sources of noise in their classes. 21% of respondent said that railway noise was one of annoying sources of noise in their classes, and other respondents said other activities as sporting activity. This means that the most noise sources in classes in schools were from main (arterial and collector) roads, chatter in class room and scraping sounds from tables and chairs, and railway.

Students‟ ratings of annoyance to the sounds heard during lessons the sounds were heard: sounds coming from inside the classroom and mechanical sounds elicited lower ratings of annoyance compared to sounds from outside the classroom. A repeated measures ANOVA with type of sound as the dependent variable revealed a small but significant effect of type of sound on annoyance ratings, F (2, 4861) = 93.43, MSE = .26, p < .001, $p\eta 2$ = .04. Bonferroni corrected post hoc procedures confirmed significant differences between annoyance ratings to types of sound in the following direction: annoyance to sounds from outside the classroom >annoyance to mechanical sounds > annoyance to sounds from inside the classroom (all ps < .001).

3.5 Academic achievement indicators

Fig. 2 shows the comparison of NS3(61.5 dB) and NS 1(56 dB)f students in the period of study. The mean cumulative scores of the 4 basic naturals science subjects in both classroom students appeared to be higher in 2013, though the differences were not significant. However, the mean cumulative scores in NS 1 students were significantly higher NS 3 students (p<0.05).

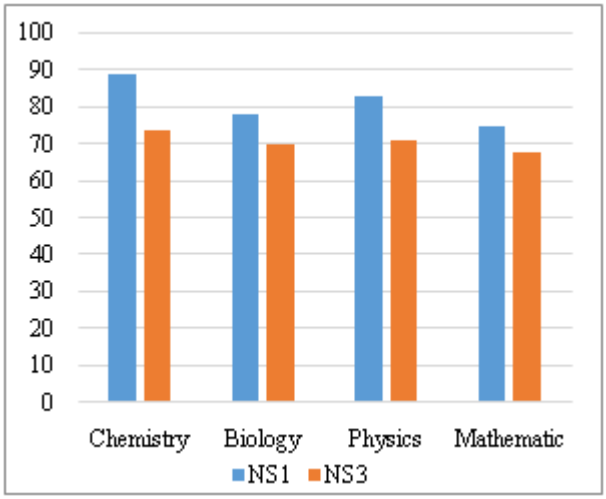

Figure 2: The value of learning outcomes graders NS1 and NS3

Fig. 3 shows the comparison of SS2(65.7 dB) and SS 3(56 .2 dB)f students in the period of study. The mean cumulative scores of the 4 basic naturals science subjects in both classroom students appeared to be higher in 2013, though the differences were not significant. However, the mean cumulative scores in NS 1 students were significantly higher NS 3 students (p<0.05).

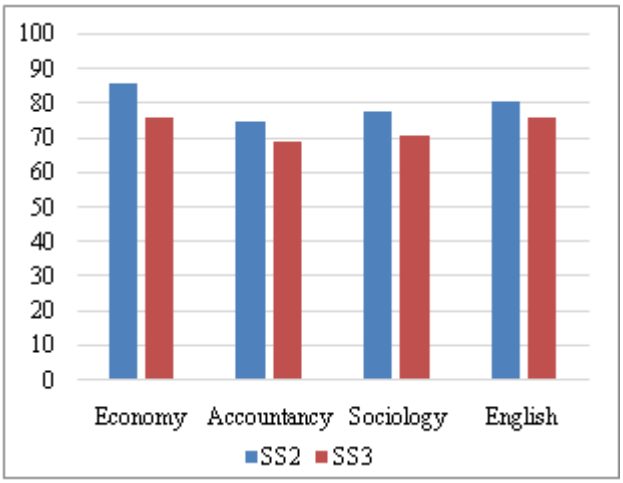

Figure 3: The value of learning outcomes graders SS2 and SS3

The study confirmed that noise affects learnig outcomes.The lower the value noise, the higher value of learning outcomes. As it is known that noise in the classroom NS1 and SS2 is lower than the noise in the classsroom NS3 and SS3.Student learning outcome NS1 and SS2 grade higher the grade students NS3 and SS3

4. Conclusion

The present study, evaluated the noise quality of classrooms in public and private schools by measuring the important noie parameters, background noise level, annoyed by school noise, Impact of Classroom noise on Teaching and Learning and Academic achievement . The measured background noise level are compared among six classroom. On comparison, it was found that the background noise in NS3 and SS3 classrooms was higher than NS1 and SS2

classroom. As well as learning outcomes of student in NS3 and SS3 classrooms was higher than student in NS1 and SS2 classroom

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