EVALUATION OF THE IMPACT OF NOISE POLLUTION ON STUDENTS IN CONGESTED AREA OF RAWALPINDI

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ABSTRACT

Noise pollution can be defined as any unwanted or offensive sound that unreasonably intrude into and disturb our daily lives. The environmental noise contributes to developmental learning, particularly in regard to speech, language and reading. Due to ongoing developments, insufficient infrastructure, increase in vehicles and absence of good learning place, the ideal conducive educational setting is disappeared. The noise in and around schools has lead to more widespread problem of children's learning behavior because noise is not only hazardous to children's mental abilities but to their overall well-being as well. The study is carried out to evaluate the impact of noise on students in a congested area of Rawalpindi with the main objective to investigate and assess negative impacts of noise on students and teachers to provide a better understanding of how and why sound affects on learning ability of students. Saidpur road had been selected being a densely populated and busy road, which runs parallel to Murree road at 0.5 kilometers distance apart and originate from Pandora Chowk to Banni Chowk with an approximate length of 6.0 kilometers. Four schools were selected as sample schools for the study on this road. A sample population of 100 students and 20 teachers were selected for the questionnaire survey by taking 25 students and 5 teachers from each school. Questionnaire was designed to gather students' and teachers' perception about the noise problem in their schools. The sound pressure levels were recorded with the help of sound level meter (A-Weighted) on the road, inside school compound and in the occupied classrooms. The results obtained from study are compared with World Health Organization Standards on noise levels for classroom. It is concluded that noise levels are higher than the recommended levels in all the schools and have serious impact on student learning.

Keywords: *Noise pollution, Noise impact, Noise level*

1. INTRODUCTION

Prudence (2004) suggests that noise can interface the students' learning based on their reading, motivation, and language and speech acquisition. Klatte, Hellbrück, Seidel, and Leistner (2010) directed that good speech communication between student and teacher is essential for learning and poor classroom acoustics seriously interfere with this process. Currently, there are plenty of private schools housed in residential areas which are not properly designed for school purpose and lack basic facilities. No sound insulation has been provided to protect the children from intrusive external noise. Inadequate urban planning is one of the cause of noise especially traffic noise. Locating educational and community buildings on main roads without any buffer zones or adequate sound proof design technique generate noise problems. Stansfeld et al. (2005) has suggested that school children are exposed to various types of noise including external environmental noise, internal noise and noise generated within classrooms by students. Noisy conditions have direct negative effect on learning, particularly language and reading development and also cause indirect problems to learners by distracting or annoying them Woolner and Hall (2010). Careful acoustic design considerations in a building can reduce the effects of noise pollution (Ibrahim & Richard, 2000).

The current research is to ascertain impact of noise on student's reading and learning ability, and speech intelligibility. The noise is defined as "combination of noise coming from outside school and generated inside classrooms due to crowding, equipment and other source". The study focuses on finding the affect of high noise level on student's behavior and impact of noise on teacher's performance in the congested area of Rawalpindi. To evaluate the noise impact on student 04 out of 320 private schools functioning in Rawalpindi were selected as case studies on Saidpur Road, Rawalpindi as representative schools of congested areas and located on main traffic route. A questionnaire survey has also been carried out from sample population of 100 students and 20

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teachers (25 students and 5 teachers from each school) to collect the requisite information. Analysis and conclusion is directed towards possible recommendations.

2. NOISE CONTROL IN CLASSROOMS

According to Woolner and Hall (2010) poor physical environment of school has detrimental effects on student's learning and behavior. The optimal learning environment depends upon many physical facilities including noise control (Helen, 1985) and the provision of noise control enhances the learning process and helps the teachers to optimize the teaching methods.

Noise can cause hearing impairment, interfere with communication, disturb sleep, reduce performance and also cause changes in social behavior. According to the research conducted by World Health Organization Guideline (1999) noise can adversely affect performance in reading, attentiveness, problem solving and memory. To decrease social impact of environmental noise, the noise must be kept in allowable limits as advised by WHO. Shield and Dockrell (2008) suggests that noise has detrimental effects upon children's performance including reduced memory, motivation and concentration. Bradley (2005) also indicated that noise can interfere with student learning affecting their reading, motivation, language and speech acquisition, and memory. The strongest area where students find the difficulty in studying is through listening and because of that there are negative effects shown by the student's behavior towards education.

High noise level reduces the attention and concentration of teachers and students. Classroom noise often exceeds the recommended levels and cause difficulty for children to learn (Prudence, 2004). Godson, Shendell, Brown, and Srindhar (2009) carried out research to find out how to promote enhanced learning environments for children for improvement in performance and health of the students and teachers. Evidence suggests that health problems potentially associated with large and chronic (continuous or intermittent) exposures to noise within the school environment are lack of concentration and tiredness. Due to high noise, the students feel annoyed. Resultantly, the learning ability of students is adversely affected. Noise also negatively affect the concentration of teachers during delivery of lectures and can cause interference to teacher-student communication (Abel, 2002). Therefore, noise affect learning abilities and the general productivity of children in terms of their academic performance.

3. CLASSROOM ACOUSTICS

Poor classroom acoustic plays a very important role as an educational barrier for children who are hearing or speech impaired and students whose mother tongue is other than teaching language. Wetherill (2002) investigated the impact of noise on classroom acoustics considering different aspects like design, shape, size, noise, type of walls, doors, windows and floor. The findings suggest that if the classroom is occupied having low ceiling and low co-efficient of reverberation than the classroom is acoustically good otherwise the classroom will be acoustically poor. Previous research shows that background noise and reverberation adversely affect learning abilities of young children. Reverberation can be controlled by the use of readily available sound-absorbing wall and ceiling materials that comply with building code requirements. Clothing provides additional sound absorption.

In acoustically poor classrooms the high noise levels cause decrease in speech intelligibility of students, when distance from the teacher is increased which can be improved by acoustical treatment of classroom and shaping of the space (Kryter, 1996). Adequate number of students with appropriate shape and size of class can enhance the speech intelligibility of students. The American National Standards Institute Published Standard of Acoustics (2002) and formulated new standards for acoustical performance criteria, design requirements and design guidelines for new classrooms and renovated existing classrooms in order to achieve high degree of speech intelligibility in learning spaces. Good classroom acoustics can be achieved if the reverberation time is less, which has positive effect on student's learning and teacher's concentration (Lubman, 2001) as children are more affected by reverberation than adults because their listening experience is not fully developed.

4. NOISE MITIGATION MEASURES

Path control or interrupting the path of sound can reduce sound exposure by creating fixed or movable noise barriers. Properly designed barriers can offer reduction in sound levels up to 20-25 dB. Shield receptor is the more effective option. The most common type of receptor shielding is the head phones and ear plugs. Sound masking can often be utilized to reduce noise annoyance like air conditioners, fans and electronic equipment that produce continuous white or pink noise to cover up intrusive sounds. According to Construction Noise Handbook, published by United States Department of Transportation (2010) following are few mitigation techniques which provide help for decreasing the noise intensity and improvement of environmental conditions.

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- Alternative design options
- Mitigation at the source
- Mitigation along the path
- Mitigation at the receiver

The most feasible technique is to control the noise by mitigation at receiver which can be achieved by adapting the following measures.

- Building envelope improvement
- By installation of noise barriers
- Masking
- Relocation of residents.

Many noise abatement programs such as the school insulation program, the quite road surfacing program and the retrofit noise barrier program can be implemented to reduce impact of traffic noise on existing noise sensitive receivers (Environmental Protection Department, 2001). Road resurfacing can also help redressing road traffic noise. Highway traffic is a major source of noise problem in which high traffic noise travel through a path and reaches at the receiver. The severity of problem depends upon the strength of the noise source or the length of the path (Environmental Protection Department, 2001). The following methods are helpful for mitigation of environmental noise;

- Land use planning
- Alternative sitting alignment
- Screening by noise tolerance buildings
- Building disposition
- Noise barrier/ enclosure
- Architectural/ balcony
- Building orientation and innovative layout
- Open-textured road surfacing
- Acoustic insulation of receiver.

5. GUIDELINES FOR NOISE POLLUTION

Although WHO is not an authority to prescribe the limits of noise, it recommends some permissible limits of noise which are advisory for member states. When multiple adverse health effects are identified for a given environment, the guideline values are set at the level of the lowest adverse health effect (World Health Organization Guideline, 1999). For public awareness WHO also declared the fourth Wednesday in April as International Noise Awareness Day (INAD) in which all member countries of the world observe 60 seconds of no noise from 2:15 to 2:16 pm. Unfortunately, in Pakistan most of the people lack any idea about the ways in which noise pollution could be controlled. Generally, people are not aware of the adverse effects of noise pollution.

Pakistan Environmental Protection Agency (Pak-EPA) has responsibility to control environmental noise pollution but in the absence of specific, “Noise Pollution Act” the increasing noise pollution can not be brought within desirable limits. Pak-EPA is the adequate forum to arrange formation of the draft Noise Pollution Act and seek approval from National Assembly. Currently, there is no specific and detailed legislation to control the noise pollution except Pakistan National Environmental Quality Standards that are only for motor vehicle noise and allow the maximum permissible noise emission limit of 85 dB (A). But there is no standard to deal with noise emanating from the activities of industrial, commercial and residential areas.

6. RESEARCH DESIGN

With the aim to assess how much the student’s learning ability is affected by noise pollution, the study undertakes the evaluation of these aspects through checking of different variables.

The sampling constitutes four private schools located at Saidpur road, Rawalpindi for evaluation of noise impact on students and teachers. These four schools were selected as purposive sample being located on one of the busiest road in Rawalpindi. A sample population of 100 students and 20 teachers was selected for the questionnaire survey by taking 25 students and 5 teachers from each school. Four types of research tools had been applied for collection of requisite information from sample schools.

- Questionnaires have been designed separately for students and teachers to assess the comments of students and teachers regarding impact of noise pollution and its related adverse effects on the respondents.
- Information regarding various environmental aspects was collected and recorded on observation sheets.

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- The sound level meter (audiometer) has been used to measure mean sound levels at various locations in the schools. Readings have been recorded in observation sheets.
- Photograph of particular situations were taken to highlight different aspects.

7. CASE STUDIES

There are approximately 320 registered private schools functioning in Rawalpindi as informed by District Education Officer, Rawalpindi. These schools work under the administrative control of provincial government and functioning under approved byelaws. Four schools were selected for the current study.

8. FINDINGS

8.1. Physical Condition of School Buildings

The sample schools were visited to check physical conditions and different environmental factors. The neighborhood of all sample schools is very noisy with semi commercial activities (Figure 1). Table 1 shows physical characteristics and conditions of the available basic amenities in sample schools. These characteristics were assessed during the physical survey of each school.

Table 1. Physical Characteristics of Sample Schools

Basic Information of Schools	School No. 1	School No. 2	School No. 3	School No. 4
Year of Construction	1980	1964	1986	1976
Type of Building	Double storied	Single storey	Double storied	Double storied
Neighborhood	Congested & Semi Commercial	Congested & Semi Commercial	Congested & Semi Commercial	Congested & Semi Commercial
Physical Condition	Average	Poor	Average	Poor
Total Area (m^2)	450	340	570	460
Covered Area (m^2)	310	240	370	360
Play Ground (m^2)	120	100	200	100
No. of Students	343	195	362	300
No. of Teachers	13	8	10	11
Average Students/ Class	28-34	20-25	29-35	26-30
Basic Amenities Assessed by physical survey	Adequate	Deficient	Average	Average
Cleanliness	Satisfactory	Unsatisfactory	Satisfactory	Unsatisfactory
Sound Insulation on Doors/Windows Assessed by physical survey	Not Provided	Not Provided	Not Provided	Not Provided
No. of Support Staff	9	5	7	6
Construction Material Assessed by physical survey	RCC, Brocks & Wood	RCC, Steel & Bricks	RCC, Brocks & Wood	RCC, Steel & Bricks
Traffic on Road Assessed by sound meter	Fast & Noisy	Fast & Noisy	Fast & Noisy	Fast & Noisy

Many school facilities are found old, out of date, poorly maintained, and lack specific design elements (Figure 2) that are likely to enhance teaching, learning, behavior and other desirable outcomes. Buildings are not constructed according to the schools standard and design (Figure 3).

8.2. Sound Levels Recorded at Road Crossings

The traffic on Saidpur Road consists of mix transport having mainly light vehicles (Figure 4). Heavy trucks 3-6 per hours were also noticed moving on road. The sound pressure levels (SPL) at all road crossings were measured between 1100 hrs and 1400nhrs for three days with the help of sound level meter. Recorded SPL at different crossings are mentioned in Table 2.

8.3. Sound Levels Recorded in Schools

The measurement of noise level has been made at different locations in school. Sound level measurements were made inside fully occupied classroom for continuous 20 minutes in each class during lesson. Table 3 shows noise levels recorded in schools.

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8.4. Questionnaire Survey

Separate questionnaires were distributed among students and teachers keeping in view the age of children. Twenty five students per school aged 10-13 years and 5 teachers from each school were surveyed. Data from students and teachers has been scrutinized and shown in Table 4 and 5 and also can be seen in Figure 5 and 6. Table 6 shows that speech intelligibility of students (83%) is the highly prevailing problem in the classroom. The data also provides evidence that speech intelligibility and learning ability are the most affected components. Such noise conditions prevailing in the schools ultimately generate lack of concentration and cause tiredness.

Figure 1. Commercial activity with traffic situation

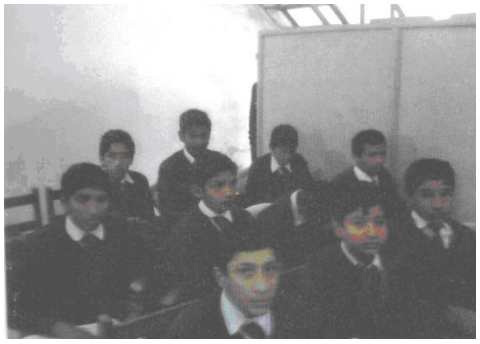

Figure 2. View of the Hall that converted into classrooms by Hard Board Partitions in School

Figure 3. Interior view of residential building that is being used as School 2

Figure 4. Existing Traffic situation in Saidpur Road

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Table 2. Sound Levels recorded at Important Road Crossings

S. No.	Important Road Crossings	Maximam SPL	Minimum SPL	Average
1	Siddiqi Chowk	86	75	80.5
2	Haidery Chowk	83.5	70.5	77
3	Kalitanti Chowk	87	72.5	79.7
4	Asgharmall Chowk	89	78.5	83.7
5	Banni Chowk	82	73	77.6

Table 3. Sound Pressure Level recorded in Schools

School	SPL at the Main Gate dB (A)	SPL inside School Compound dB (A)	SPL in Classroom dB (A)
1	77.4	70.3	58
2	78.3	69	59
3	76	72.2	56.2
4	76.2	68.5	55.7
Average	77.2	70	57.2

Table 4. View of Students about Impact of Noise on School Performance

S. No.	Statements with reference to Noise	Percentage
1	External noise affect concentration	75
2	High noise cause negative effect on behavior	66
3	High noise effect on reading ability	77
4	High noise decreases student's listening ability	71
5	Students are disturbed by intermittent noise	51
6	Students are affected by road noise	41
7	Students feel tiredness due to high noise	65
8	High noise reduces social interaction and enjoyment	62
9	Noise reduces students learning ability	64
10	High noise interfere with speech intelligibility	71
11	Students experience headache due to exposure to noise	64
12	Speech communication is affected by noise	71
13	Noise cause conflicts with their class fellows	55
14	Students will feel good if noise is controlled	82

Table 5. View of Teachers about Impact of Noise on Delivery of Lectures

S. No.	Statements with reference to Noise	Percentage
1	External noise affect concentration during delivering lectures	50
2	Noise affects teaching	74
3	High noise cause interference in communication between students and teachers	95
4	High noise cause reduction in social interaction	65
5	They will feel better if noise level is reduced in the class	77
6	Noisy environment reduces comfort level	60
7	Behavior is affected by noise	64
8	Due to high noise they can not deliver lectures properly	58
9	Teachers concentration is affected by road noise	37
10	High noise cause child to exhibit tiredness	64
11	Students learning ability is affected by noise	72

Table 6. Comparison of Reading, Learning, Speech Intelligibility and Behaviour as responded by the students and teachers

Variables	Reading Ability (%)	Learning Ability (%)	Speech Intelligibility (%)	Behavior (%)
Student's Survey	64	77	71	66
Teacher's Survey	72	75	95	64
Average Values	68	76	83	65

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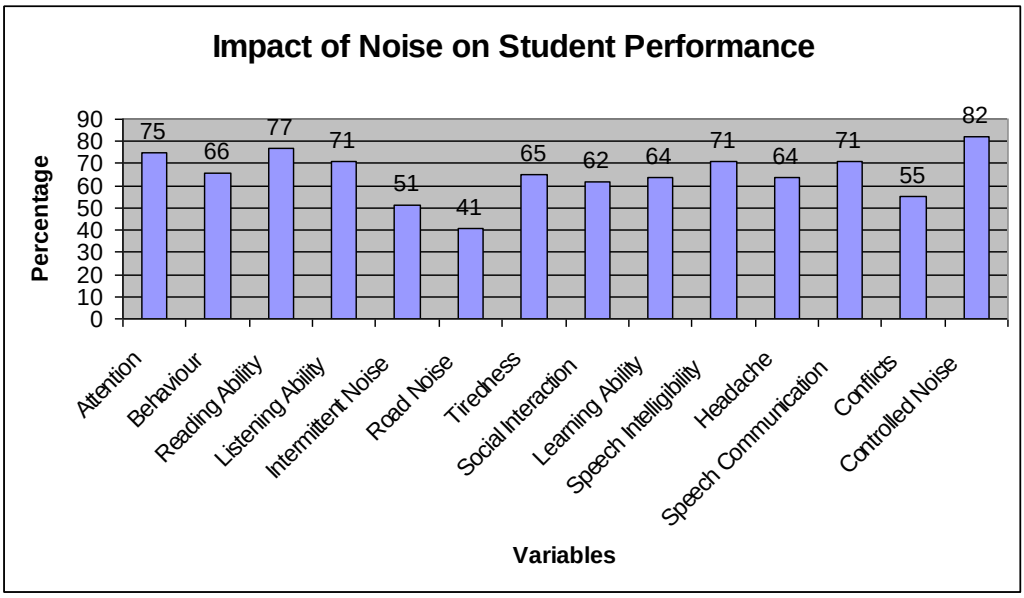

Figures 5. Impact of noise on Student's Performance

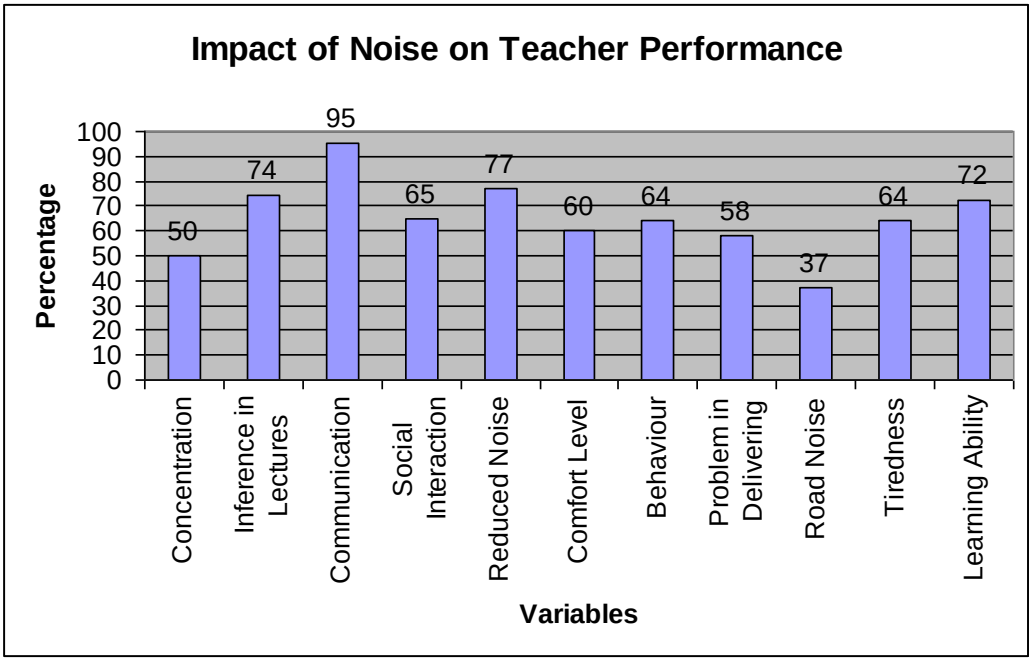

Figure 6. Impact of noise on Teachers' Performance

9. ANALYSIS

Noise pollution around educational area can negatively affect the performance of students as well as teachers (Bradley, 2005). The study found that noise level indoors (classrooms) and outdoors (playgrounds) across schools was higher than WHO permissible levels. The WHO recommended background noise is permissible up to 45 dB (A) whereas, all these four schools have noise level more than 55 dB (A). Therefore, based on the findings, school 3 and school 4 have better classroom noise level as compared to the other two schools. Also the American National Standards Institute (ANSI) provides limits for both background noise level and reverberation times. According to these standards noise level in school area should be around 35 dB (A) inside classrooms 45dB and in play ground 55 dB (A). The maximum SPL was found in school compound that is 72.2 dB (A) but according to WHO recommendations allowable noise level inside school should be 55 dB (A), whereas, allowable noise level in the classroom must be 45 dB (A) for better learning environment, while all four schools have noise level more than 55 dB (A).

It is evident from the survey that the variables like reading ability, learning ability, speech intelligibility and behavior of students are adversely affected by high classroom noise. It has been found from survey that high

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background noise has a major negative impact on student's performance. From a comparative perspective, respondents reported a lack of concentration and decrease in listening ability and this corresponds to 75% and 71% respectively. The results obtained and their variations may be traced to the fact that most of the schools are located close to main road and are readily affected by noise from vehicle engines in degrees dependant on their individual proximities to the road.

Excessive noise and reverberation interfere with speech intelligibility, resulting in reduced understanding and therefore reduced learning. It is more difficult for them to hear individual sounds clearly, as when learning to read and spell and their concentration is also compromised. The need for good classroom acoustics and the methods for attaining them have been known for decades but this information has not been made readily available to architects, school planners, administrators, teachers and parents.

10. CONCLUSIONS AND RECOMMENDATIONS

The findings from the research have revealed that rate of noise level prevailing in the sample schools is very high and more than 55 dB (A) which is higher than WHO recommended allowable noise level that is 45 dB (A). These noise levels are not suitable for student's learning activities and cause reduction in speech intelligibility and learning ability along with tiredness that reduces student's as well as teacher's concentration. According to American National Standards Institute (ANSI) noise level in school area should be around 35 dB (A) inside classrooms 45dB and 55 dB (A) in play ground and WHO recommendations for allowable noise level inside school should be 55 dB (A). The maximum SPL was found in school compound is 72.2 dB (A) which is higher than both standards.

Therefore, it has been recommended that school building must be properly designed to accommodate effective learning opportunity. The schools should reconsider the number of students in each class that should not exceed the recommended noise level. The existing condition of school can be improved by applying sound insulation measures on doors and windows and apply sound absorption materials on all surfaces. To reduce the noise level from main road traffic it is recommended to have maximum vegetation inside school ground. Also it is recommended to periodically assess the physical condition of schools and noise level inside and outside school.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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REFERENCES

Abel, K. (2002). Noise pollution in the classroom, family education, Retrieved from: http://school.familyeducation.com/child-psychology/educational-research/38357.html.

American National Standards Institute Published Standard of Acoustics. (2002).

Bradley, J. S. (2005). Does the classroom assist or impede the learning process. *Journal of Canadian Language and Literacy Research Network*.

Environmental Protection Department, H. K. (2001). Guidelines for implementation of noise abatement programs", Retrieved from: www.epd.gov.hk/epd/english/resources.

Godson, R., E., E., Shendell, D., G., Brown, G., E., & Srindhar, M., K., C. (2009). Assessment of noise and associated health impacts at selected secondary schools in Ibadan, Nigeria. *Journal of Environmental and Public Health, 2009*, 1-6.Available at: https://doi.org/10.1155/2009/739502.

Helen, B. (1985). The developing child (4th ed., pp. 531-537). New York: Published by Harper and Row Publishers.

Ibrahim, Z. H., & Richard, H. K. (2000). Noise pollution at school environment located in residential area. *Malaysian Journal of Civil Engineering, 12*(2).

Klatte, M., Hellbrück, J., Seidel, J., & Leistner, P. (2010). Effects of classroom acoustics on performance and well-being in elementary school children: A field study. *Environment and Behavior, 42*(5), 659-692.Available at: https://doi.org/10.1177/0013916509336813.

Kryter, K., D. (1996). *Handbook of hearing and the effects of noise*: Emerald Group Publishing Limited.

Lubman, D. (2001). Noise and learning. Retrieved from: www.nonoise.org/quietnet/qc/INCEinitiative.htm.

Prudence, A. (2004). Impact of school-aged children", Research Paper Presented In the 147 ASA Meeting at New York NY.

Shield, B. M., & Dockrell, J. E. (2008). The effects of environmental and classroom noise on the academic attainments of primary school children. *The Journal of the Acoustical Society of America, 123*(1), 133-144.Available at: https://doi.org/10.1121/1.2812596.

Stansfeld, S. A., Berglund, B., Clark, C., Lopez-Barrio, I., Fischer, P., Öhrström, E., . . . Van Kamp, I. (2005). Aircraft and road traffic noise and children's cognition and health: a cross-national study. *The Lancet, 365*(9475), 1942-1949.Available at: https://doi.org/10.1016/s0140-6736(05)66660-3.

United States Department of Transportation. (2010). Construction noise handbook on highway construction noise. Retrieved from: www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook07/cfm

Wetherill, E., A. (2002). Design classroom for good hearing. Retrieved from: www.quiteclassroom.org/library/goodhearing.htm.

Woolner, P., & Hall, E. (2010). Noise in schools: a holistic approach to the issue. *International Journal of Environmental Research and Public Health, 7*(8), 3255-3269.Available at: https://doi.org/10.3390/ijerph7083255.

World Health Organization Guideline. (1999). (p-xviii) for noise control. Retrieved from: www.who.int/docstore/peh/noise/guidelines2.html

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