

Research Article

The Effects of Noise on Learners in the English First Additional Language Foundation Phase Class

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Abstract

This paper reviews issues relating to the effects of noise on learners in the Foundation Phase. The qualitative summative evaluation was followed in the study. The semi structured interviews were conducted with 9 participants, which are 2 district officials, 3 Grade 1 educators, 1 class assistant, 2 principals, 1 head of department, and Grade 1 learners from the three mainstream schools in Bojanala District in the North West Province, South Africa. The methodology employed in this research emphasised the effect of the utilisation of the dynamic sound field amplified system (DSAS). The findings show that all participants have the experience of the background noise in the classrooms. This deterred affected educators to be audible and for learners to hear the educator clearly. The background noise, factors affecting speech intelligibility in the classroom; noise effects on academic and educator performance and the effects of the environmental noise were some of the factors mentioned as impediments to effective teaching and learning. The use of the DSAS was revered by educators and learners alike as improving teaching and learning due to the significant reduction of background noise in the classroom. The study concluded that after extensive review of national and international literature, there is a need for further research concerning mainly by outlining some current acoustic standards for classrooms.

Keywords

Otitis Media, Reverberation, Speech Intelligibility, Signal-to-Noise Ratio

1. Introduction

The article reports on a study conducted on issues relating to the effects of noise on teaching and learning of English First Additional language in the mainstream primary school. There is growing concern with the Foundation Phase learners having to learn in noisy classrooms. This is due to the fact that it negatively affects their academic performance and speech intelligibility [34]. The effects of chronic exposure of environmental noise in the classroom are worrying. Many studies have examined the effects of background noise and reverberation on learners' cognitive processing taking into considera-

tion their academic performance at school [34]. These young learners have difficulty processing speech in a noisy classroom that also has reverberation [18].

Listening is an important skill that young learners should acquire, due to the fact that most teaching and learning at school is presented orally [18]. Learners with auditory processing disorders show clear signs in the Foundation Phase, whereupon they are classified as learners with learning barriers [31]. Learners who manage to listen attentively, under desirable listening conditions become successful learners [18].

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Classroom acoustics has a significant role to play in speech intelligibility [34, 18]. This indicates that no one aspect is responsible to create an environment that will be conducive for teaching and learning in the foundation phase. The World Health Organisation (WHO) came up with guidelines that should be used when building schools.

A variety of researchers recommend the reverberation time (RT) should not exceed 35 dBA in an empty classroom [18]. These guidelines are seldom used, resulting in inadequate teaching and learning environments. If classroom settings considered the impact of interior acoustic factors to facilitate appropriate teaching environment, cost-effective improvements can be put in place/ensured in schools [18].

Background noise refers to any undesired auditory stimuli that interfere with what a learner needs to hear and understand [9]. This includes external noise transmitted through the building into a classroom. The noise inside a classroom may include noise from teaching equipment like computers and projectors. Dominant source of noise in a primary school classroom is the noise generated by the individual learners talking, as they take part in a range of classroom activities, sliding of chairs or tables, and shuffling of shoes on non-carpeted floors. Background noise sources in the classroom include external noise that is noise generated from outside of the classroom such as playgrounds, lawnmowers, airplanes and motor vehicles [9]. The background noise sources in the classroom affect the learners' speech intelligibility. This study used the RT because it amplifies the educator's voice above the background noise, including the external noise like that of an aeroplane [40]. The educator's voice remains audible to all learners in the classroom with the use of the DSAS [14].

2. Background to the Study

According to [24] state that it is typical to find a number of learners with mild hearing loss in most schools. These are the learners who need improved classroom acoustics to lessen the negative impact of auditory disorders on learning. In the beginning of 2013, in the school in Brits, North West Province, a Grade 1 boy in an Afrikaans medium mainstream school was diagnosed with mild hearing loss. He was fitted with a hearing aid, but still struggled with his schoolwork. The school requested Inclusive Education officials to intervene. After deliberations with the school, parents, the speech therapist and the audiologist, it was agreed to order a DSAS which was compatible with the boy's hearing aid for use in the classroom. The boy's performance improved significantly. It was found that not only this boy's work improved, but the performance of all learners in the classroom improved, because the educator was more audible to everyone. The reason for this improvement was that the sounds which the boy had found difficult to distinguish were suddenly made easy to identify and articulate. The background noise sources in the classroom affect the learners' speech intelligibility, and with the use of

the DSAS the background noise was reduced.

Speech intelligibility is about understanding how to achieve the optimum speech clarity and precision in the learning environment that is critical in today's classrooms. Speech intelligibility is about the effectiveness of speech to be understood by the listener, Speech intelligibility adds value to both learning and teaching. For speech to be intelligible, it is essential to have adequate audibility and adequate clarity. For the voice to be audible, the signal-to-noise ratio (SNR) is crucial. The voice is highly modulated, and so while intelligibility measurements do incorporate audibility, it is not to the same standards used for audibility of tone generating systems. Speech intelligibility also provides reassurance to educators, learners and parents about the learning environment. It enhances learning outcomes in an engaging and interactive way [27, 10].

A major effect of noise and poor acoustics in the classroom is the reduction of speech intelligibility. If learners are unable to understand the teacher then the major function of a classroom in providing an environment that enables the transfer of information from educator to learner is impaired. Furthermore it is important, both for learning and social interaction that learners are able to hear and understand their peers in the classroom [33].

It has been shown through research how learners of differing ages understand speech in noise and reverberation teaching and learning environment. Young learners are susceptible to poor acoustic conditions than senior learners, due to either permanent damage to their hearing or a temporary condition such as a cold or ear infection (*otitis media*) [24]. It is common to find a number of learners with mild hearing loss in most schools [24]. Learners with hearing impairment are affected by noise and reverberation than those with normal hearing [34].

3. Noise Effects on Academic and Teacher Performance

A major effect of noise and poor acoustics in the classroom is the reduction of speech intelligibility. If learners are unable to understand the educator then the major function of a classroom in providing an environment that enables the transfer of information from educator to learner is impaired. It is important that learners are able to hear and understand their peers in the learning environment, both for learning and for social interaction [34].

According to [3] states that classrooms are busy places and can also be noisy environments. He mentions that learners are often expected to listen even in poor acoustic classrooms. Noise is a problem for everyone, but some learners experience more difficulty than others. This includes Foundation Phase learners with temporary hearing loss from ear infections, learners with auditory processing, language or learning disabilities, and EFAL learners. As argued by [3], in spite of all the

above-mentioned challenges, learners should be enabled to learn to listen in a sea of noise.

According to [36] there are number of learners with “normal hearing” who experience difficulties in a classroom where there is noise or reverberation. They explain that the ability to listen in a noisy environment is not developed until a child reaches adolescence. It is one of the challenges that young learners in the townships and rural schools are faced with because of overcrowded classrooms which make it difficult for the educator to be audible enough to all learners in the classroom.

Learners who are taught in the language that is not their home language have difficulties and struggle with predicting or filling in the language gaps, particularly when hearing under adverse listening conditions and with hearing impairment [6]. This can affect learners emotionally and leave them feeling inadequate and incompetent in their school work [33]. The Aboriginal and Torres Strait Islander learners are taught in an informal way and are less reliant on verbal interaction as the predominant medium of learning [19, 38]. Their focus is more on peer interaction as a source of communication and learning. Learners naturally learn through observing their peers and being helped by peers [16]. Young learners sometimes struggle to differentiate their educator’s voice from chatter of classmates [11, 31].

South African young learners who are not native English speakers face the same problems as the Aboriginal and Torres Strait Islander learners [38]. Even though learners are encouraged to interact in the learning environment, educators as facilitators still play a vital role [4] Therefore it is important for the educators to be audible when they teach.

The ability of a non-speaker of the language to comprehend spoken English in a noisy background is related to the listener’s ability in and experience of the language [9, 24]. Often the English phonemic differences are subtle. The above-mentioned researchers gave an example of the two different English sounds, the ‘b’ and ‘v’, which are pronounced the same in Spanish [23].

The signal-to-noise ratio (SNR) is defined as the ratio of the power of a signal (*meaningful information*) to the power of background noise (*unwanted signal*) [9]. In an unoccupied conducive classroom it should be about 15 dBA and never exceed 35 dBA. Younger learners require a better SNR for them to be able to perform better at speech recognition tasks [25].

According to [25] one of the factors of acoustics in a room is reverberation time (RT). This can be defined as time in seconds needed for sound pressure at a specific frequency to decay 60 dB after the sound source has stopped. Shorter RT’s are required, rather longer ones which reduce the clarity of speech and negatively affect intelligibility [18]. Therefore longer RT’s intercepted by undesirable noises, resulting in reduced speech clarity.

Reverberation is explained as a sound caused by overlapping of multiple echoes. Reverberation in classrooms

arises from sound being reflected off hard walls and high ceilings. Therefore, if the noise level is low the reverberation will also be low. A low SNR and low reverberation both improve the acoustics and the conduciveness of the classroom. This again highlights the importance of classroom acoustics especially for learners in the foundation phase, to always aim for (higher) or maximise SNR in the 0.8 seconds condition [25].

According to [39] when classrooms are being designed, it is important to consider the teaching activities that will occur inside the rooms during the course of a school day. Acoustical considerations must facilitate the different teaching methods employed. The ideal classroom should be acoustically friendly for all learners with different abilities and for all teaching styles. Furthermore, classrooms should not only be acoustically effective when the learner has normal hearing and is sitting quietly on the mat close to the educator. The classroom should also accommodate the hearing-impaired learner during group discussions, when there are high levels of noise [39].

In South Africa, like in other countries, primary school learning in small groups is encouraged and more emphasis is put on incidental learning. Classrooms are generally noisier and more active places today than in the past decades. It is discouraged for learners to sit quietly and listen to their educator for the whole day. It has been my experience that modern teaching strategies expect learners to interact in the classrooms as they learn. Noise levels are probably higher in these classrooms than in countries where more traditional teaching methods are used. This may create barriers to communication and impose constraints on listeners [24]. This is especially true when young learners are taught an additional language. However, most classrooms in South African rural and farm schools are not structured to accommodate these changes in teaching styles [39].

According to [30] refers to a study of classroom acoustics conducted in three Johannesburg primary schools; seventy teachers participated in the study. The purpose of the study was to investigate primary school teachers' knowledge of and attitude to the impact of poor classroom acoustics. The study also examined their knowledge of how excessive background noise could be a barrier to learning. It is important for teachers to be well aware of this barrier. The findings of this study showed that the majority of the participants did not have in-depth knowledge of classroom acoustics and the negative impact of poor acoustics on both educators and learners [30].

The three schools that I conducted a study in the educators were aware of the background noise in their classrooms. They however thought that if only learners can be quiet it will be better. This could have been expecting miracles from the young learners, also contradiction, because they are expected to interact with their peers in their groups when they learn.

4. Infrastructure

In Foundation Phase classrooms educators add their own soft furnishings, which help absorb noise [39]. Curtains, large rugs, empty cardboard egg trays as wall panels and putting four tennis balls on metal legs of each chair in classrooms that do not have carpeted floors are cheap and common strategies that are used in the classrooms to absorb the noise [29].

The noise in the classroom is made up of external noise, which is channelled through the building envelope, and internally produced noise [34]. Learners in a classroom may be exposed to noise from different sources. External noise often consists of environmental noise such as delivery trucks, vehicles, motorbikes and aeroplanes. External noise can also come from factories, learners who are outside on break and people outside the schoolyard, or natural noise such as rain falling on the school roofs, thunder and wind. Outside noise and activities like traffic, and learners in corridors or playing outdoors can make it difficult for an educator in a junior class to get her learners' attention. This could be caused by what they see and hear. Therefore windows are the main culprits for letting sound from outside into the classroom. One way of reducing the outside noise is insulating the windows with the installation of sound-reducing glass, it is however extremely expensive [5].

Another common way that is effective with reducing distraction is hanging curtains on the windows. The disadvantage of the curtain is the outside can still be heard inside the classroom. Very few schools are exposed to railway noise [34]. Most of the examples above are common in urban schools. In this study Swallows was the only school that is in town.

5. Noise Level in the Classroom

The signal-to-noise ratio (SNR) is defined as the ratio of the power of a signal (*meaningful information*) to the power of background noise (*unwanted signal*) [9]. In an empty classroom the noise level should be about 15 dBA (*decibels as perceived by the human ear*), and never exceed 35 dBA [9]. Reverberation is explained as a sound caused by overlapping of multiple echoes. Reverberation in an unoccupied classroom should not exceed 0.7 second [39]. Reverberation in classrooms arises from sound being reflected off hard walls and high ceilings. Therefore, if the noise level is low the reverberation will also be low. A low SNR and low reverberation both improve the acoustics and the conduciveness of the classroom [9]. As argued by [39], when classrooms are being designed, it is important to consider the teaching activities that will occur inside the rooms during the course of a school day. Acoustical considerations must facilitate the different teaching methods employed.

The ideal classroom should be acoustically friendly for all learners with different abilities and for all teaching styles. Furthermore, classrooms should not only be acoustically effective when the learner has normal hearing and is sitting

quietly on the mat close to the educator. The classroom should also accommodate the hearing-impaired learner during group discussions, when there are high levels of noise [39].

The three schools are built with bricks and mortar, which is a good structure. The challenge that Makgona has is that the classroom is too small for the large number of learners. The Grade R classes are just behind the Grade 1 classrooms. At neither Swallows nor Mooi was there any evidence of poor infrastructure. In none of the schools did the structures make provision for less reverberation, which is negative factor and increases the background noise in the classrooms. This was also shown by the results that I got from a speech therapist and audiologist when she measured the background noise in the classrooms with no learners.

6. Theoretical Framework

For this study Chen's programme theory evaluation (PTE) [7] was employed. It was appropriate to evaluate the utilisation of the DSAS in the three schools because of its simplicity. PTE laid the foundation of the evaluation process for this study, it is also perceived as theory of action, as it focuses on the five levels of evaluation to bring change. Those levels are promoted, provide, produce, assess/evaluate and achieve. The PTE and the theory of change will specify the strengths and weaknesses of the DSAS. This guide schools to adapt or change the strategy for the sake of learners. The PTE is important to monitor the success or the failure of the programme and also to assist if there is an area that needs more attention to improve the programme. All the above ideas are considered in the theoretical framework of the treating of the background noise in this study.

7. Methodology

This research followed a non-probability, purposive sampling technique [13]. One school was a former model C (*school for the previously advantaged community*), the second a former farm school and the last one a rural school. The selection was done according to the geographic location, bearing in mind the diversity of the South African population, i.e. different racial groups and socio-economic background [12]. This enriched the data and enhanced the credibility of the findings.

All the learners were in Grade 1 in the three primary schools in the North West Province. Pseudonyms were used for the names of the schools for the purpose of this study. Those names are Makgona, Mooi and Swallows. The three schools have Grade R, but the Mooi School's Grade R class is privately owned. The average age of the learners was six years turning seven years in Grade 1. Makgona School, the Grade 1 classroom had 63 learners, it was overcrowded. In the other two classrooms the number of learners was manageable (*31 and 36 learners*). The schools accommodate learners with different

abilities. The communities around the three schools have different socio-economic backgrounds. Makgona is in a rural community, with a poor socio-economic background. Mooi is in a farming community with an average socio-economic background. Swallows is in an urban community, with a good socio-economic background. The three Grade 1 educators, one class assistant, the Grade 1 learners in the three classrooms and one HOD, two principals and two district speech and language therapist and audiologists were the participants in this study. The observations for the study were conducted in the three Grade 1 classes and were supplemented with data from the participants through semi-structured interviews conducted with three educators, one class assistant,

Ethical permission for this research was obtained from the Pretoria University's Ethical Clearance Committee and consent was obtained from the North West Department of Education, the school, the educator and the parents. Assent letters were used to get the Grade 1 learners' consent [26].

Data collection and documentation is an essential stage of the research, without them one cannot have credible data [32]. Data was collected through interviews, a reflective journal, field notes, photos and observation in the participants' natural environment (Makgona, Mooi and Swallows Schools [22]. Semi-structured interviews were conducted with all the participants, and a conversational interviewing style consisting of open-ended questions was adopted [32].

Observation is an organised method of collecting data relying on the ability to gather data without questioning the participants [32]. Observations reports for three schools were kept in the form of field notes [15, 17].

Recording non-verbal expressions of feelings and what I heard was vital [35]. I used tape recorder and reflective journal for my notes. The process also assisted me to spot challenges on an ongoing basis. I kept in mind that often a behaviour observed can be strange or atypical, and this can be a threat to my study [37].

Data analysis started immediately when information from the interviews and observations had been collected [20]. It was immediately recorded to get a clear understanding of the information gathered. This assisted to understand the Grade 1 learners and their educators' experiences in the noisy classrooms. The data obtained was analysed using content and document analysis. Content analysis is about scrutinising and analysis of observation procedures and interview transcripts to ascertain emerging themes from the study [21].

Document analysis is a form of qualitative research in which documents are interpreted by the researcher to give voice and meaning to the study. Analysing documents includes coding content into themes similar to how interview transcripts are analysed [1].

The qualitative analysis process includes reducing raw data to work with the important information only [28]. I separated and fused emerging themes by separating and taking apart the data and putting it back together [8].

8. Findings

Good classroom interaction requires an environment where learners can hear and comprehend what is being said in the classroom. It is equally important for an educator to hear learners and for learners to hear their peers [2]. The educator's ability to teach depends on the ability of all learners in the classroom to hear [11].

The Swallows educator supported this when she said:

The DSAS has made my work easy to work with my learners and those diagnosed with disabilities. My learners sometimes struggle to differentiate Afrikaans and English, However the DSAS assist the learners to hear the difference. Almost all learners in the classroom have the knowledge of sounds and their reading skills have been developed. One great advantage of the DSAS is that when an aeroplane passes, my voice automatically goes higher than the disrupting noise.

The DSAS was highly appreciated by Makgona School educator because her class was overcrowded, and she said:

I do not have to scream when I teach my learners. My voice is equally audible to all learners. It is easy to manage a huge class; my learners are calm, and more attentive. Even when I teach the new sounds I do not have to repeat it over and over again even for learners who are struggling. This has improved their performance and participation in the classroom.

The DSAS has assisted with the effective teaching and learning in all schools and learners were attentive most of the time. However the Swallows School educator still struggled with the two boys whose disabilities were diagnosed as severe, and needed more support than other learners in the classroom. The two district speech therapists and audiologist (SLA) said the following about the use of the DSAS:

Yes, they are essential. They will assist young learners whose hearing is not well developed.

Normal hearing learners still can benefit from them, because background noise is significant reduced which increases attention and concentration.

Sub-standard infrastructure and its impact on the efficacy of the DSAS Good infrastructure is critical in the teaching and learning environment. In all three schools, no major disadvantage of the use of the DSAS to the educators and learners was highlighted.

The two district SLAs, the two principals and the HOD raised the issue that having DSAS for Grade 1 classes only is not enough. The device is vital for all educators to have, more especially in the Foundation Phase (FP).

SLAs:

The Grade 1 learners' listening skills would not be fully developed by the end of the year. Nobody should be surprised when the same learners' performance drops.

Educator:

We only have DSAS in the Grade 1 class and not have them in other classes; some of the learners' performance might deteriorate. It would be better if the whole Foundation Phase is catered for.

9. Conclusion

In this study educators found themselves straining their voices for the learners to hear them. In Makgona School the educator had 63 learners in the classroom. Even though she had a class assistant it was important for all learners to hear her. The background noise and reverberation made it difficult for educators and learners to be audible. The study found that the participants were not aware of the importance of acoustics in the classroom. Stressful, unhealthy, frustrating and time consuming as it was, they did not have any choice. They had to speak at the top of their voices and often repeated themselves for their learners to hear and understand, and they had accepted the situation as it was.

Abbreviations

DSAS	Dynamic Sound Field Amplified System
CAPS	Curriculum Assessment Policy Statement
dB	Decibel
dBA	Decibel A
EFAL	English First Additional Language
FP	Foundation Phase
HOD	Head of Department
LOLT	Language of Learning and Teaching
PTE	Programme Theory of Evaluation
RT	Reverberation Time
SLA	Speech Therapists and Audiologist
WHO	World Health Organisation

Author Contributions

Mpho Otlametse Marumo is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The author declares no conflicts of interest.

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