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# Perceived effects of background noise on the learning experiences of English first- and second-language female learners

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Noise, although ubiquitous, is seldom considered as a factor that may impede learning. In South Africa, most learners are multilingual and learn in English, which is their second language. Most noise studies have been conducted in the Global North, where the school context differs from the Global South. In this article, using questions selected from the Strengths and Difficulties Questionnaire, we present a quantitative evaluation of the perceptions of background noise on learning of a purposive sample of 154 Grade 10 to 12 female learners attending 2 all-girls schools, who were either learning through English as their second, or as their first language. The responses of first language and second language learners were compared using Mann-Whitney *U* tests with Hodges-Lehman estimates. Second language learners reported greater interference and annoyance from noise, compared to their first language peers. This may be due to the additional cognitive demands required when processing complex information in a second language. Given the high proportion of learners who are learning through a language that is not their mother tongue, we highlight the importance of a good acoustic environment to counteract the negative effects of the increased cognitive demand when processing information in a second language. Educators should consider ways to mitigate interference from noise and to improve the saliency of the acoustic signal in their classrooms.

**Keywords:** classroom noise; cognitive overload; English second language; noise; sound management

## Introduction and Background

Children are more negatively affected by background noise than adults. The ability to understand speech against background noise is a developmental skill which matures around the age of 15 years (Elliott, Connors, Kille, Levin, Ball & Katz, 1979; Johnson, 2000). This means that school children have varying levels of ability to adequately understand (and learn from) speech in noisy environments. Learners who are learning in their mother tongue take verbal communication for granted, but those learning in a second language need to expend more cognitive resources to hear the spoken word in order to process and understand the content (Connolly, Dockrell, Shield, Conetta & Cox, 2015; Seabi, Cockcroft & Goldschagg, 2013; Stansfeld, Berglund, Clark, Lopex-Barrio, Fisher, Öhrström, Haines, Head, Hygge, Van Kamp & Berry, 2005). In most South African schools (including the two schools surveyed in our study), a teacher-centric lesson delivery model is followed in the sense that the teacher stands at the front of the class to speak and provide information and instruction. Learners listen and then usually complete tasks in their workbooks. Such an approach relies on good acoustic listening conditions for optimal learning to occur. If learners cannot clearly hear the words that teachers speak or the questions that their peers ask, their learning will be affected (Connolly et al., 2015; Seabi et al., 2013; Stansfeld et al., 2005).

Despite this, little consideration is given to the effects of noise on school learning. Most research on this area was on the effects of long-term noise on children or the effects of a reduction of noise on performance in Global North contexts (Byers, Mahat, Liu, Knock & Imms, 2018; Stansfeld et al., 2005; Visentin, Prodi, Cappelletti, Torresin & Gasparelli, 2019). The context of schools in developing countries of the Global South differs from those in the Global North. In South Africa, for example, most learners are multilingual and are learning in English as a second language. Together with structural issues, such as over-crowding, poorly built and designed classrooms, and the geographic location of schools without consideration of the impact of noise from nearby buildings, road - or air traffic, this indicates that the role of noise in impeding learning warrants investigation. Additionally, an understanding of South African learners' perceptions of noise in their school environment would provide insight into their experiences of learning in classrooms where background noise levels may be significant.

In the study reported on here we took an interpretivist approach to explore learners' perceptions of noise in their school environments and how this may impact their learning. We were interested in surveying the perceptions of female Grade 10 to 12 learners whose abilities to perceive speech in noise should be at, or close to, adult-like levels. Furthermore, we were interested in understanding whether there were differences in the perceptions of background noise and learning between English second language (EL2) and English first language (EL1) learners. In addition to providing information about how EL1 and EL2 learners may be differentially affected by background noise, this study has important implications concerning the placement of new schools (to either provide new buildings, or to upgrade existing, poorly constructed classrooms).

## Literature Review and Theoretical Framework

Classroom noise is unwanted or disliked sound, which makes it difficult for learners to attain a valued goal – in this case an education (Stallen, 1999). Numerous studies have shown the association between physical characteristics of school buildings including noise, and unfavourable educational outcomes (Barrett & Zhang, 2009). Poor classroom acoustics and high levels of ambient noise (classroom chatter, furniture scraping, corridor noise) contribute to the noise (Massonnié, Frasseto, Mareschal & Kirkham, 2022) and negatively impact learners' ability to learn (Dockrell & Shield, 2006; Goswami, Hassan & Sarma, 2018). Not hearing a teacher's voice can give rise to a sense of loss and frustration, which can lead to annoyance and helplessness. To cope with the noise, learners have to expend more cognitive effort to decode the desired message (Pichora-Fuller, Kramer, Eckert, Edwards, Hornsby, Humes, Lemke, Lunner, Matthen, Mackersie, Naylor, Phillips, Richter, Rudner, Sommers, Tremblay & Wingfield, 2016). In addition, noise affects students' ability to perceive nuances in speech. EL2 learners are particularly vulnerable to this effect. In fact, it is suggested that a higher signal - (teacher's voice) to-noise ratio is needed for EL2 learners (Gremp & Easterbrooks, 2018; Nelson & Soli, 2000).

An unfavourable signal-to-noise ratio reduces the clarity of the teacher's voice, which is necessary for the auditory processing of information, and impedes full comprehension. In noisy environments, the cognitive demands for listening increase, compromising other cognitive functions (Visentin et al., 2019). The cognitive demands expended when listening in a second language, in which one is not fluent, are already high without the added burden of a noisy environment.

Environmental noise includes sounds external to the classroom (e.g. road traffic, aircraft), or sounds from within the school itself (e.g. chairs scraping the floor, voices, etc.). When many people congregate in smaller spaces, such as classrooms, their voices create a noise (referred to as babble), from which it is difficult to interpret speech meaningfully and easily. This babble is particularly significant for EL2 learners, where reduced speech intelligibility complicates the already significant challenge of learning through a second language (Nelson & Soli, 2000).

When listening in their mother tongue, EL1 learners can supplement signal-dependent information (such as the availability and strength of the teacher's voice) with signal-independent information, by using the linguistic knowledge of their home language (Nelson, Kohnert, Sabur & Shaw, 2005). An example of this is that EL1 learners have an intuitive understanding of the word order in sentences (signal-independent information), which supports their understanding of the overall meaning of the sentence, regardless of how loudly (signal-dependent information) the teacher is speaking. The interpretation of that signal by the listener, informed by linguistic knowledge, is signal-independent information. In contrast, EL2 learners are less able to draw on signal-independent information to support signal-dependent information since they are less able to rely on oral language experience of the second language to provide a strong linguistic knowledge. This oral language experience has accumulated over time for their EL1 peers. This is an important consideration in South African classrooms, given that English is the most widely used language of teaching and learning and that the majority of learners learning in English are not EL1 speakers (Probyn, 2018).

Another important consideration is the way in which learners perceive and react to noise (Massonnié et al., 2022) as this impacts which personally valued outcomes are threatened by noise exposure (Stallen, 1999). The way people perceive, and are affected by noise is not only determined by the physical characteristics of the noise itself, but also by contextual factors, i.e. the ability to concentrate, work and engage appropriately with and in the situation (Hede & Bullen, 1981). A study on student perceptions of noise found that adolescent learners are, "… sensitive judges of the acoustical qualities of their learning environment and are able to reliably identify the acoustic conditions that interfere with their learning" (Connolly et al., 2015:3118). Second language learners who participated in that study were significantly more negatively affected by noise than their EL1 peers. Given these differences and the importance of understanding how noise may impact learning, we surveyed and compared the noise perceptions of EL1 and EL2 female high school learners (between the ages of 14 and 19 years).

## Methodology

We employed a quantitative, non-experimental, two-group comparison research design. Using questions adapted from the Strengths and Difficulties Questionnaire (Stansfeld et al., 2005), female high school learners' perceptions of background noise were investigated to determine the extent to which such noise was perceived as interfering with their learning. It was hypothesised that EL2 learners would be more sensitive to classroom noise than their EL1 peers and, hence, more aware of its negative consequences with regard to their learning.

### Description of the Schools and Physical Classroom Space

We used purposive sampling to identify and select learners from similar socio-demographic backgrounds from two all-girls schools. Age, gender, socio-economic status, and education phase (high school) were kept the same between the two groups to reduce the number of non-acoustic confounding variables (as suggested by Stallen, 1999). Both schools were situated in similar suburban neighbourhoods, with similar road traffic movements. Classrooms at both schools were constructed from brick and mortar. There was no mechanical ventilation at either school; fresh airflow was obtained through open windows. The classroom walls were made of brick, were plastered and painted; floors were made of concrete or wooden tiles. There were no curtains or sound-absorbing carpets, which could affect acoustic characteristics. The sound environment constituted non-impulsive intermittent sounds typical of those normally heard in classrooms (i.e., learner and teacher voices, furniture scraping and moving). There were no railways or airports located near the schools. The main external noise sources were from road traffic and other sounds typical of a city environment.

### Participants

Learners in Grades 10, 11 and 12 attending the two all-girls schools described above were invited to respond to an anonymous questionnaire about their noise perceptions. The participants' ages ranged from 14 to19 (School A: mean age: 16 years; *SD* 0.99; School B mean age: 16.17 years; *SD* 0.94). This age range was selected as this is the point at which children's ability to understand speech in noise stabilises and becomes adult-like (Elliott et al., 1979; Johnson, 2000).

Ninety-four participants from School A returned completed questionnaires of which 84 reported that they were EL1, while 10 were EL2 learners. Sixty responses were received from School B, of which 54 were EL2 and six were EL1 (cf. Table 2). In total, 90 EL1 and 64 EL2 learners completed the questionnaire. No hearing impairments were reported by the participants.

### Description of the Survey Methods Used

Survey questions were selected from The Strengths and Difficulties Questionnaire. This questionnaire was previously used in the Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health (RANCH) study (Stansfeld et al., 2005) and the RANCH-SA (South Africa) study (Seabi et al., 2013; Seabi, Goldschagg & Cockcroft, 2010), which examined the exposure-effect relationships between aircraft and road traffic noise exposure and children's cognition and mental health. Participants were invited to complete a hard copy of this 31-item questionnaire anonymously to provide insight into their perceptions of noise (cf. Table 4 for the questions). Part 1 of the survey dealt with perceptions of noise, while Part 2 dealt with annoyance and disturbance resulting from noise. A total of 154 completed questionnaires were received and used in the analysis. Responses were recorded using five Likert-scale type options: Always (= 1); Usually (= 2); About half the time (= 3); Seldom (= 4); Never (= 5). The responses were coded and captured into a spreadsheet for further analysis.

### Sound Level Measurement

Sound level measurements of both unoccupied and occupied classrooms were taken to establish the sound levels at the two schools. Measurements were made in six classrooms (three at each school) using a Svantek 955 Type 1 sound level meter. The instrument's calibration was checked with a Rion NC74 acoustic calibrator, prior to, and after the measurements. Calibrations were consistent and remained in range throughout the measurements. The sound level meter was mounted on a tripod at a height of 1.2 metres (the height of an average seated person's ear level) and placed at least 1 metre from the internal walls. The measurements included the following metrics: average sound level (LAeq); maximum sound level (LA max); minimum sound level (LA min); and the level exceeded for 90% of the time (L90). Measurements of unoccupied classrooms were taken when the school was empty. Ambient sound level measurements of occupied classrooms were made during a typical school day, with normal teaching activity underway. The types of activity taking place were noted. These were typical for a classroom and included the teacher's voice, children discussing their work (babble), desks and chairs moving and scraping, and external sounds (cars, footsteps, shouts).

### Ethics

Ethical clearance was obtained from the authors' academic institution. Prior to commencement of the study, written informed consent was obtained from the schools' principals, the participants, and their parents/guardians, with opportunity for withdrawal without prejudice. Anonymity and confidentiality of results were assured.

## Results

### Sound Level Measurement Results

Sound level measurements taken by the authors are shown using the LAeq descriptor in Table 1. LAeq was selected as an appropriate metric since it is defined as the "… value of the A-weighted sound pressure level of a continuous steady sound that, within a specified time interval, *T*m, has the same mean-square sound pressure as a sound under consideration whose level varies with time …" (Standards South Africa, 2008:5). The World

Health Organisation and the South African National Standard SANS10103 recommend a level of 35 decibels LAeq for unoccupied classrooms (Standards South Africa, 2008). Note that the noise level in all the classrooms exceeded the recommended level by between 2.7 and 12.5 dBA LAeq.

**Table 1** Measured LAeq sound levels at each school

| School A | | | | | |
|---|---|---|---|---|---|
| Classroom A | | Classroom B | | Classroom C | |
| Unoccupied | Occupied | Unoccupied | Occupied | Unoccupied | Occupied |
| 44.2 | 64.6 | 38.5 | 58.9 | 37.7 | 64.2 |
| School B | | | | | |
| Classroom A | | Classroom B | | Classroom C | |
| Unoccupied | Occupied | Unoccupied | Occupied | Unoccupied | Occupied |
| 47.5 | 59.4 | 41.2 | 68.7 | 44.7 | 60.8 |

To determine whether the two schools were similar or not in terms of their levels of noise, noise measurements between schools in unoccupied ($U$ = 8.00; $p$ = .20) and occupied ($U$ = 5.00; $p$ = 1.00) classes were compared using Mann-Whitney $U$ tests. There were no significant differences between the schools, indicating that they were comparable in terms of how noisy they were, both when occupied and unoccupied. A Kruskal-Wallis test showed that, as would be anticipated, occupied classes were significantly noisier ($z$ = .0001; $p$ = .031) than unoccupied classes.

### Questionnaire Results

In the first analysis we compared the ages of learners (which we extracted from the survey responses) across the two schools. There was no significant difference between their ages ($t$ = 0.15, $p$ = .878) indicating that the samples were equivalent in this demographic. The age range at School A ($M$ = 16; $SD$ = 0.99) was 14 to 18 years, while the age range at School B ($M$ = 16.17; $SD$ = 0.94) was 15 to 19 years.

In the second analysis we examined the numbers of EL1 and EL2 learners in each school (cf. Table 2).

**Table 2** Frequencies and percentages of EL1 and EL2 learners at each school

| School | Language | Frequency | % |
|---|---|---|---|
| A | EL1 | 84 | 89.36 |
| | EL2 | 10 | 10.64 |
| | Total | 94 | 100.00 |
| B | EL1 | 6 | 10.00 |
| | EL2 | 54 | 90.00 |
| | Total | 60 | 100.00 |

Most learners attending School A spoke English as their first language, while the learners in School B were mostly EL2. For the remaining analysis, learners were regrouped by home language.

Our main interest was whether the EL1 and EL2 learners differed significantly from one another in terms of their perceptions of how noise in the school environment impacted their learning. Mann-Whitney $U$ tests with Hodges-Lehman estimates were calculated to compare EL1 and EL2 learners' responses for each item of the questionnaire. Items that differed significantly between the language groups are shown in Table 3.

**Table 3** Items showing significant differences between EL1 and EL2 learners on The Strengths and Difficulties Questionnaire

| Item | $W$ | $p$ | Hodges-Lehmann estimate | 95% CI for Hodges-Lehmann estimate: Lower | Upper |
|---|---|---|---|---|---|
| P1_Q2 | 3750.00 | < .001**** | 1.00 | 5.91 | 1.00 |
| P1_Q4 | 2056.50 | .001*** | -2.956 | -1.00 | -2.987 |
| P1_Q6 | 1716.50 | < .001**** | -1.00 | -1.00 | 1.00 |
| P1_Q7 | 3385.50 | 0.027* | 2.593 | 4.213 | 1.00 |
| P1_Q8 | 3644.00 | 0.002** | 1.00 | 2.438 | 1.00 |
| P1_Q12 | 2303.00 | .039* | -5.597 | -1.00 | -4.741 |
| P2_Q2 | 1737.00 | 0.003** | -1.00 | -6.594 | -1.00 |

*Note.* P1 = Part 1 of Questionnaire; P2 = Part 2 of Questionnaire; Q = Question; α = .05; CI = Confidence Interval; *$p$ < .05; **$p$ < .001; ***$p$ = .001; ****$p$ < .0001.

Mann-Whitney $U$ tests were run to determine whether there were differences in survey question responses between EL1 and EL2 groups. Distributions of the survey question responses for each home language group were similar, as assessed by visual inspection. As shown in Table 3 (generated by the authors), of the 31 questions posed, mean ranks of survey question response differed significantly between the language groups for seven questions (Part 1, Questions 2, 4, 6, 7, 8 and 12, and Part 2, Question 2), using an exact sampling distribution for *U*. The questions posed by the authors are listed in Table 4. For these questions, the EL2 group reported more interference and annoyance from noise compared to the EL1 group, even though the objective noise measurements from both schools were not significantly different. In general, responses from learners at both schools show that they were aware of background noise which interfered with learning and concentration approximately half of their school time (cf. Table 4).

**Table 4** Median responses on the noise questionnaire for both schools combined

| Questions Part 1 | Always | Usually | About half the time | Seldom | Never |
|---|---|---|---|---|---|
| 1) When you are at school and **indoors** is it **quiet**? | | | x | | |
| 2) When you are at school and **outdoors** is it **quiet?** | | | | x | |
| 3) When you are at school and **indoors** is it **noisy**? | | | x | | |
| 4) When you are at school and **outdoors** is it **noisy**? | | x | | | |
| 5) When you are in class does it feel calm? | | | x | | |
| 6) Do you hear noise from **road traffic** when in class? | | | x | | |
| 7) Do you hear noise from **other classes** when in class? | | | | x | |
| 8) Do you hear noise from the **corridor** when in class? | | | x | | |
| 9) How often are you **annoyed** by noise from outside your classroom when you are in class? | | | x | | |
| 10) How often do you want to tell your teacher that noise is **worrying** you in class? | | | x | | |
| 11) How often do you feel noise is affecting your ability to **concentrate** in class? | | | x | | |
| 12) How often do you struggle to follow what the teacher is saying because of noise **inside** your classroom? | | | x | | |
| 13) How often do you struggle to follow what the teacher is saying because of noise **outside** your classroom? | | | x | | |
| 14) How often are you **aware** of noise while you are doing **independent written work** in class? | | x | | | |
| 15) How often are you aware of noise while you are **writing a test** in class? | | x | | | |
| 16) Do you find that noise at school **disturbs or interferes** with **working in a group**? | | | x | | |
| 17) Do you find that noise at school **disturbs or interferes** with **independent written work** in class? | | x | | | |
| 18) How often do you struggle to concentrate because of noise **inside** the classroom? | | | x | | |
| 19) How often do you struggle to concentrate because of noise **outside** the classroom? | | | x | | |
| 20) When at school, how often do you deal with noise by carrying on with your work? | | | x | | |
| 21) When at school, how often do you deal with noise by switching off (tuning out)? | | | x | | |
| 22) When at school how often do you deal with noise by waiting for it to finish? | | | | x | |

| Questions Part 2 | Always | Usually | About half the time | Seldom | Never |
|---|---|---|---|---|---|
| 1) In general, how annoyed are you by sounds you hear when you are at school? | | | x | | |
| 2) How much does noise from road traffic bother, disturb or annoy you when you are in class? | | | | x | |
| 3) How much does noise from other classes bother, disturb or annoy you when you are in class? | | | | x | |
| 4) How much does noise from the corridor bother, disturb or annoy you when you are in class? | | | x | | |
| 5) How much does noise in your classroom, disturb, or annoy you when you are in class? | | | x | | |
| 6) How often do you wish your school were quieter? | | | x | | |
| 7) How much do you think noise affects how well you work at school? | | | x | | |
| 8) How often do you feel like telling others to keep quiet so that you can concentrate? | | x | | | |
| 9) How often does noise make you feel stressed or irritable? | | x | | | |

Responses show that learners generally did not wait (or perhaps could not wait) for noise to die down before continuing with their work. Learners appeared least affected by road traffic noise and noise from other classes.

Spearman's correlations were run separately for each home language group to determine which questions were inter-related. Similar patterns of significant correlations were observed for each language group with the questions from Part 1 strongly related ($r$ = .20-.63, $p$ = .05 to $p$ < .001 for EL1 and $r$ = .16-.67, $p$ = .05 to $p$ < .001 for EL2), and similarly for Part 2 ($r$ = .21-.64, $p$ = .05 to $p$ < .001 for EL1 and $r$ = .16-.57, $p$ = .05 to $p$ < .001 for EL2). This means that the questionnaire was tapping into similar constructs regarding noise perceptions and annoyance. The EL2 group showed a greater number of significant correlations between the questions. The perception of the extent of noise questions showed many significant correlations, with the questions tapping feelings of annoyance/disturbance due to noise. This suggests that the questions were tapping similar constructs for the two groups of learners.

The two questions that showed the fewest correlations with the others were Part 1, Question 5: "When in class does it feel calm?" and Part 1, Question 6: "How much road traffic noise is there when in class?" This suggests that feelings of calmness in class and awareness of road traffic noise were generally not associated with the issues tapped by the other questions.

## Discussion

In general, responses from learners at both schools show that they were aware of background noise which interfered with learning and concentration approximately half of their school time. We were particularly interested in determining whether EL2 learners would be more sensitive to classroom noise than their EL1 peers, hence more aware of its negative consequences on their learning. The results indicate that EL2 learners perceived their school environment to be significantly noisier outdoors than their EL1 counterparts. Further, the EL2 learners reported greater awareness of noise from road traffic, the corridor and other classes and to be more disturbed or annoyed than the EL1 learners. They also reported struggling more than their EL1 counterparts to follow what the teacher was saying, because of internal classroom noise. These findings suggest that actual noise interference is not perceived equally by first and second language learners, since there was no significant difference between the schools on the objective noise measurements. This concurs with the findings of Yang and Mak (2018) that English speech intelligibility scores in Hong Kong are always lower for second language speakers compared with native speakers of English. It supports the notion that EL1 learners can use signal-independent information to supplement signal-dependent information, whereas EL2 learners are less able to do so. It is well known that noise (of whatever kind and at whatever intensity level) has significant repercussions for auditory discrimination and speech perception (Shield & Dockrell, 2003) as well as attention and memory (Tristan-Hernández, Pavon-García, Campos-Cantón, Ontañon-García & Kolosovas-Machuca, 2017). These findings highlight the importance of a good acoustic environment to counteract the negative effects of the increased cognitive demand when processing information in a second language.

Several recommendations for addressing the undesirable effects of noise on learning can be made. The first is to reorganise the placement of learners within the classroom, as the level of teachers' voices can vary from teacher to teacher and also depends on where the learners are seated in relation to the teacher. It is important to reduce background sound levels coming from within the classroom and from the corridor outside to ensure the best acoustic condition for listening. Educators (in the broadest sense of the term) need to be aware of the need to ensure minimal processing effort in speech perception (Visentin et al., 2019). This can be done by considering three interconnected aspects of sound management in classroom settings: (a) teachers should recognise the unique combination of acoustic and learner characteristics present in their classrooms; (b) ways to reduce noise during instructional activities should be considered; and (c) the level of the teacher's voice should be raised, particularly during literacy- and numeracy-based activities.

## Summary and Conclusion

The perceived effects of noise at school, as well as practical steps that learners and teachers can take to minimise these, need further investigation. Our results are relevant to the acoustic design and location of schools in relation to noisy environments (airports, highways, taxi ranks), to the formulation of policy on noise and child health, and to a broader consideration of the negative effects of environmental stressors on children's cognitive abilities, which align with the findings of Massonnié et al. (2022) in their research on learning in noisy classrooms. In this study we have shown that noise is relevant for both EL1 and EL2 learners, but that EL2 learners perceived greater interference from noise.

A good acoustic environment is achieved through a combined reduction of noise from sources external to the classroom (e.g. road traffic) and internal babble (Puglisi, Cantor Cutiva, Pavese, Castellana, Bona, Fasolisa, Lorenzatti, Carullo, Burdorf, Bronuzzia & Astolfia, 2015). Acoustic treatment of classrooms in South Africa is unlikely to happen while so many learners still attend schools that are in deplorable conditions and without water or electricity. The backlog in basic school infrastructure improvement will first need to be addressed. Hence, noise from within schools will need to be managed by the educators themselves to improve listening conditions for EL2 learners since any lessening of noise levels in schools should result in improved children's cognition (Basner, Babisch, Davis, Brink, Clark, Janssen & Stansfeld, 2014).

This study could contribute to a strategic reconsideration of classroom design by considering the factors that contribute to effective learning environments, similar to work done in Organisation for Economic Cooperation and Development countries (Byers et al., 2018). Education authorities and teachers have a responsibility to ensure the best possible conditions for children's cognitive development. In South Africa, where learners consistently perform at the bottom of internationally benchmarked maths and science tests when compared with other countries (Reddy, Visser, Winnaar, Arends, Juan, Prinsloo & Isdale, 2015), classroom noise is one of many challenges to be tackled for learners to reach their potential and become economically active citizens.

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## Authors' Contributions

PLG and TB conceptualised the study, conducted the fieldwork and collated the raw data. KC ran the statistical analysis. All three authors contributed to analysing, writing and reviewing the manuscript.

## Notes


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