

INVESTIGATING PERCEPTION OF CHILDREN IN PRIMARY SCHOOL CLASSROOMS: A THEMATIC ANALYSIS

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Abstract

Classroom acoustics research has traditionally focused on objective acoustic measurements and speech intelligibility, while comparatively limited attention has been given to the subjective experience of the children in the classroom sound environments. This study explores primary school children's perceptions through a qualitative analysis and examines how these experiences relate to the conceptual framework proposed in ISO 12913-1 for soundscape research. Data were collected through focus group interviews with 22 students (ages 6-12) in Pakistan using semi-structured open-ended questions. The interviews were analyzed using a thematic analysis, conducted through a theoretically informed, deductive approach guided by concepts from ISO 12913-1 and the study's research questions, combined with the inductive identification of patterns emerging from the children's responses. The analysis revealed several key themes related to children's experiences of the classroom acoustic environment, which were connected within a conceptual framework, including the Interpretation of Auditory sensation, affective and physiological responses, behavioral adaptation, and teacher-led interventions. Children also described characteristics of an ideal classroom sound environment that supports concentration and well-being. The findings provide an opportunity to compare children's perspectives with previously proposed frameworks based on adult viewpoints, hence contributing to a more user-centered understanding of classroom acoustic environments.

Keywords: *Classroom acoustics, indoor soundscape, qualitative analysis, primary school, focus group*

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1. Introduction

While soundscape research gained significant attention in outdoor urban contexts, its application to indoor environments, particularly educational settings, remains limited [1], [2]. In educational settings, classroom acoustics have traditionally focused on the objective characterization of learning spaces through parameters such as sound pressure levels, reverberation time, and speech intelligibility, given their established importance for communication and learning [3], [4]. However, this approach has often overlooked the subjective and contextual nature of acoustic experience. A perceptual approach, which is examining how individuals interpret and respond to their sound environment has been increasingly recognized as essential for a more comprehensive understanding of classroom sound environments.

On the other hand, the concept of soundscape, as defined in ISO 12913-1 [5], emphasizes the perceptual dimensions of acoustic environments. It highlights the interaction between the physical environment, auditory sensation, and human responses like affective and behavioral outcomes [6]. Moreover, the existing literature indicates that indoor soundscapes are influenced not only by spatial and architectural factors but also by contextual and social elements [7], [1].

In educational environments, the shift from objective acoustic measurements to a subjective, perception-based approach is particularly relevant, as students' cognitive performance, well-being, and comfort are influenced not only by noise levels but also by the type, meaning, and appropriateness of classroom sounds. For instance, research has shown that certain sounds, such as mechanical noise, may negatively affect concentration, whereas other auditory stimuli, such as natural sounds or music, can have neutral or even positive effects on learning and comfort [8]. In school environments, recent studies have examined occupants' perception using thematic and qualitative methods, mainly focusing on feedback from adults such as teachers, staff, and acoustic experts [9], [10]. These studies emphasized the significance of classroom

activities, environmental conditions, and contextual factors for the perception and evaluation of the classroom soundscape. This adult-centered perspective represents a critical gap, as children are the primary users of classroom environments and may perceive and interpret sound differently than adults due to developmental and cognitive factors.

Existing qualitative studies in other indoor environments highlight the value of thematic analysis in capturing users' subjective experiences and interpretations of sound [11]. Previously, it was also found that users actively engage with their acoustic environment through behavioral adaptation and coping strategies [12], yet these responses remain underexplored in classroom contexts, particularly from children's perspectives.

This study is part of an ongoing research project on the soundscape of primary school classrooms (SOUNDkids project). The aim of this phase was to explore children's perceptions of classroom acoustic environments through qualitative methods, to identify key perceptual attributes, responses, semantic descriptors and contextual factors based on the children's own perspectives and language. The attributes emerging from this qualitative investigation are intended to complement those identified through the literature review [13] and will subsequently be integrated into the broader project framework to inform its later phases.

A second aim was to examine how the findings emerging from the thematic analysis align with the conceptual structure proposed in ISO 12913-1. In doing so, the present study also seeks to extend the existing school soundscape framework by Kurukose Cal et al. [9] by incorporating children lived experiences.

2. Methodology

2.1 Study settings

The study was conducted in a private primary school in Lahore, Pakistan where focus group discussions were organized to explore children's experiences of classroom sound environments. Each classroom has a rectangular plan, with desks arranged in either rows or group settings, accommodating an average of 20 to 25 students per class. The floor area is approximately 30 m² (about 4.3 m × 6.8 m), with a suspended gypsum ceiling at a height of about 3.0 m (volume ≈ 90 m³). The interior surfaces are predominantly hard and reflective - glazed ceramic floor tiles, plastered and painted masonry walls, glazed window and door openings to the corridor and courtyard, and a magnetic whiteboard at the front of the class. The rooms are furnished with solid metallic frame desks with wooden tops and chairs. Each classroom has a wall-mounted air-conditioning unit and a ceiling fan, both of which act as continuous background noise sources. The school is located in an urban area, where classrooms face the school courtyard adjacent to a nearby road, resulting in occasional exposure to external traffic noise as well. The building consists of three classroom floors and a rooftop playground on the fourth floor. Figures 1–2 illustrate a typical learning environment within the

school, along with the adjacent corridor, which opens onto a courtyard on one side and is lined with classroom doors and windows on the other.



Figure 1: Classroom interior view highlighting the organization of furniture and spatial arrangement, with rear openings (windows and door) providing visual and physical connection to the courtyard.



Figure 2: Adjacent corridor with classrooms on one side and openings toward the courtyard on the other, emphasizing the relationship between indoor learning spaces and the outdoor environment.

2.2 Participants and focus groups

A total of 22 children (16 female) aged 6-12 years were involved in the focus groups using purposive sampling, with teachers helping to identify students who were willing and comfortable participating in group discussions.

Ethical approval for the study was obtained from the Ethics Committee of the Area Vasta Emilia Centro, Emilia-Romagna, Italy (CE-AVEC, protocol 712/2025/Sper/UniFe, 11 December 2025). Institutional authorization was granted and signed by the school director as the school's legal representative, and the children's participation was covered by the general agreement signed by parents or guardians at admission, which authorizes involvement in the school's educational and extracurricular activities. Participation was voluntary, and the children were informed that the activity was not an assessment.

Semi-structured focus group discussions were conducted on a single day during lesson hours, from 10:00 to 15:00. Each session involved a small group of 5-6 students from the same grade and lasted approximately 20 minutes. Five children were selected

from Grades 1 and 2 each, while six children from each of Grades 3 and 6 participated.

The activity was conducted in a quiet classroom within the school, therefore ensuring a familiar setting that would allow the children to report on their everyday auditory experiences in a closely related space.

The interview consisted of four open-ended questions designed to explore how children perceived the sound environment of their classroom (Table 1). The questions also encouraged children to describe their preferences for an ideal classroom sound environment. The focus group discussions were conducted in English, which is the medium of instruction at the school; all sessions were audio-recorded and transcribed in English, and no translation was required to analyze the interviews.

Table 1. The four questions prepared for the focus group discussions

No.	Guiding Questions
1	What are the sounds you hear in the classroom?
2	How would you describe these sounds?
3	How do these sounds make you feel?
4	What are the sounds you prefer to hear while you're working in your classroom?

2.3 Data analysis

The transcripts of the discussions were imported into the qualitative data analysis software ATLAS.ti [14], which facilitated systematic coding and organization of the data. Verbal descriptions were analyzed through thematic analysis, defined as a method for systematically identifying and organizing patterns of meaning across a dataset [15]. The analysis followed a thematically driven approach combining deductive and inductive coding procedures. Initial codes were developed based on concepts derived from the soundscape framework proposed in the standard ISO 12913-1 and the research objectives of the study. At the same time, additional codes and patterns emerging from the children's responses were identified inductively during the coding process. Through iterative coding and categorization, recurring themes and relationships were identified and organized into broader thematic groups.

During the coding process, each sentence in the transcript was examined and meaningful statements were coded in ATLAS.ti. Key phrases were extracted from each statement and grouped according to similarities in meanings. Related phrases were then categorized into subcategories and broader thematic categories. A total of 183 key phrases were created during the first phase of coding. For example, "Leave classroom" and "Close door" were the behavioral responses of the children to the sound environment, and they were coded and categorized under a subcategory of the "Avoidance Behaviors". Similarly, "Ask others to stop" and "Whisper instead of shout" were the behaviors that were categorized under "Social Regulation Behaviors". These subcategories were then grouped under the main theme of "Behavioral

Adaptation" as the codes under these categories were related. Eventually, when all the themes, categories, and subcategories were identified along with the relationship amongst them, a conceptual framework presenting children's perception of classroom sound environment was developed. The framework has 5 themes, 14 categories and 11 subcategories.

3. Results and Discussion

The conceptual framework representing children's perception of the classroom sound environment is displayed in Figure 3. The starting point of the framework is the "Classroom acoustic environment", intended in its physical properties. The sound environment is interpreted by the children (theme "Interpretation of the Auditory sensation"), eliciting their emotional responses (theme "Affective and physiological responses"), that could be either positive or negative. The "Behavioral adaptations" to the negative responses are adopted by the children to convert the negative responses to positive, when possible. Also, these adaptations produce changes in the physical sound environment. Likewise, the "Teacher intervention" following negative affective responses of the children will influence the physical environment. The positive responses can reveal the preferences of the children for the classroom acoustic environment.

3.1 Classroom Acoustic Environment and the Interpretation of Auditory Sensation

The "Classroom Acoustic Environment" comprises the "Physical Parameters" and "Sound Sources". These represent the objective acoustic conditions in the classroom that drive how children perceive and interpret them. Thus, the theme "Interpretation of Auditory Sensation" was connected to "Classroom acoustic environment".

How children perceive and interpret the sound environment differs from the actual acoustic environment as their perception is shaped not only by physical sound properties but also by individual, contextual, and psychological factors including a child's sensitivity, attention, emotional state, and the meaning they assign to particular sounds (e.g., a teacher's voice versus peer chatter). The same acoustic conditions may therefore be experienced very differently across individuals. Hence from the analysis, a range of sound sources that children commonly experience in classroom environments were identified. These were grouped into three main categories: human sounds, object-based sounds, and external/environmental sounds. Human-generated sounds were the most frequently reported and included talking, shouting, laughing, whispering, and teacher's speech. Object-based sounds, such as chairs dragging, doors opening and closing, bags dropping, and writing on boards, were also commonly mentioned. In addition, children reported external sounds such as rain, wind, birds, and noise from outside activities.

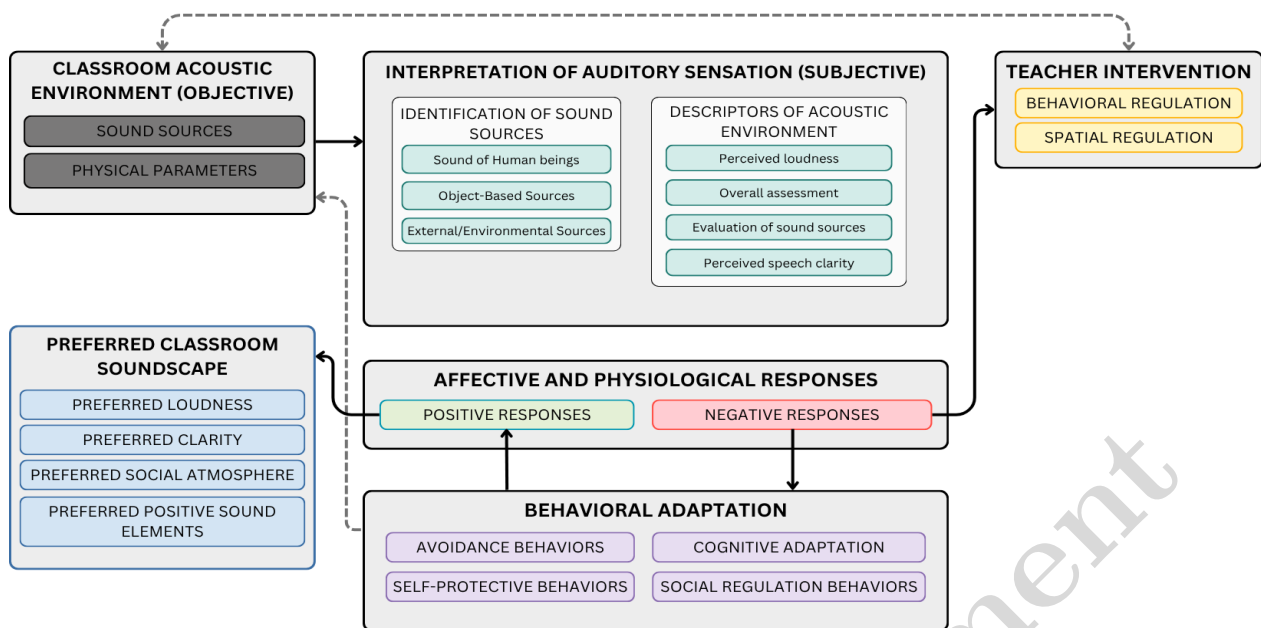


Figure 3: A conceptual framework representing children's interpretations of classroom sound environment

The "Interpretation of the Auditory sensation" also consists of another category which is "Descriptors of the acoustic environment". Children described how they interpret sound environments using various attributes. These were further grouped into subcategories such as the "Perceived loudness of sound sources", where sounds were described as loud, noisy, quiet, or slow. Children also referred to the 'Overall assessment' of the sound environment, characterizing classrooms as quiet, silent, or peaceful, or alternatively as chaotic. Another important descriptor was the "Evaluation of sound sources", where sounds were described as unpleasant, surprising, annoying, and disturbing. In addition, children frequently mention speech intelligibility, in a broad concept referring to their ability or inability to clearly hear and understand the teacher during classroom activities. The letters A and B present children's quotes related to the themes of "Classroom Acoustic Environment" and the "Interpretation of Auditory Sensation".

A: *Grade one is the new noisy class, but their noise just comes when we open the front door.*

B: *Music, also when boys are playing outside, the balls tap and I can hear their kicks of the children playing outside.*

Children demonstrated a clear ability to identify and differentiate between various sound sources in their environment. Their descriptions were specific and context-dependent, often linking sounds to activities (e.g., "chairs dragging when students move" or "noise when classmates talk"). This indicates that children are not passive receivers of sound but rather they actively interpret and categorize auditory stimuli, which is consistent with the concept of "Interpretation of Auditory sensation" in the ISO soundscape framework.

Their responses showed that perception is cognitively mediated, rather than purely sensory.

3.2 Affective & Physiological Responses

"Affective & Physiological Responses" was chosen as the core theme with the other themes shaping around it. Children's "Interpretation of Auditory sensation", "Teacher intervention", and "Behavioral adaptations" dynamically relate to "Affective and physiological responses". The letters C, D, E and F present children's quotes related to the theme of "Affective & Physiological Responses".

Positive responses reported by children included feeling good, happy, excited, relaxed, motivated, peaceful, focused, and able to concentrate.

C: *Everyone is quiet and the door is open so we can hear the leaves rustling and the birds. It really makes me concentrate.*

However, children also reported several negative responses when exposed to undesirable sound conditions. These included feelings of annoyance, distraction, irritation, stress, worry, anger, sadness, and fear.

D: *When the classroom is very loud, I feel annoyed.*

E: *When the table is being... Like it's not balanced. Like you are doing your work and suddenly you hear a sound, and your work is like a bit dirty.*

The theme included also responses strongly related to bodily reactions, such as headaches or ear discomfort. The presence of physiological responses is particularly important, as it indicates that children articulate

discomfort in embodied terms, even if not measured objectively.

F: *Inside, when they're talking too much and there's so much loud noise, like of a teacher. My head hurts.*

These findings indicated that children's experiences of the overall acoustic environment are not only limited to a (meaningful) interpretation of the sound environment but extend to emotional and bodily reactions.

3.3 Behavioral Adaptation

As the children gave negative responses, they also stated behavioral changes that they implement in order not to experience negative outcomes. To turn negative responses into positive responses, children described several strategies which were categorized into "Avoidance behaviors", "Self-protective behaviors", "Cognitive adaptation", and "Social regulation behaviors".

"Avoidance behaviors" included moving away from noise sources or leaving the classroom, while self-protective actions involved covering ears. "Cognitive strategies", such as ignoring noise or trying to concentrate despite distractions, were also commonly reported. Additionally, children are engaged in "Social regulation behaviors", such as asking peers to be quiet or informing the teacher. The letters G, H, I and J present children's quotes related to the theme of "Behavioral Adaptation".

G: *After lunch, we close both doors so that we don't even hear the noises.*

H: *Mostly when we want to talk to the person next to us, we just whisper.*

I: *whenever somebody is shouting, I am just used to it, so I keep doing my work.*

J: *When I was reading, I am used to reading in big noise, I hear and close my ear and read.*

These findings suggest that children play an active role in managing their acoustic environment. Rather than passively experiencing it, they employed a range of adaptive strategies to regulate their exposure to sound stimuli perceived as negative and maintain focus on the task-at-hand.

Moreover, it is important to note that these coded behaviors in the transcripts emerged spontaneously, without direct prompting in the interview questions, indicating that adapting to sound is a significant aspect of children's perception.

3.4 Teacher Intervention

"Teacher Intervention" included "Behavioral regulation", such as asking students to be quiet, and "Spatial regulation", such as changing seating arrangements or separating noisy students. These interventions could be elicited by both the negative

affective responses of the students and the objective acoustic environment of the classroom.

These findings highlighted that classroom soundscapes are not only shaped by students' behaviors but are also externally regulated by teachers. These interventions act as factors that can modify the acoustic environment and influence students' responses. The letters K and L present children's quotes related to the theme of "Teacher Intervention".

K: *The boys talk very loudly. And the teacher says stop talking but they still talk. When the teacher is trying to stop the boys that is also really annoying for the girls.*

L: *We called the teacher. The teacher scolded them and separated their seats.*

However, these teacher interventions should be understood as part of a dynamic and context-dependent system influencing the classroom soundscape.

3.5 Preferred Classroom Soundscape

The positive responses of children define their "Preferences" about the classroom sound environment. These were grouped into four subcategories which included codes related to Low or controlled sound level (quiet or no background noise), Clear speech and good intelligibility, a calm and supportive social atmosphere and presence of pleasant or meaningful sounds (e.g., nature sounds, friend's storytelling). The letters M, N and O present children's quotes related to the theme of "Preferred Classroom Soundscape".

M: *Like when the leaves fall from the trees and then somebody, when they step on the leaves. That's very satisfying.*

N: *Everyone is quiet and the door is open so we can hear the leaves rustling and the birds. It really makes me concentrate.*

O: *It makes me motivated when, like, the class is silent, and I can finally listen to the teacher. I can finally do my best in peace without the boys bothering me.*

These preferences, including a range of sound stimuli beside silence, indicate that children value not only a silent sound environment but also functional and meaningful sound stimuli in the classroom that support well-being and learning. The inclusion of preferred sound elements suggests that an ideal classroom is not completely silent but rather includes appropriate sound stimuli.

4. Conclusion

This study investigated primary school children's perception of the classroom sound environment using a qualitative focus group approach. It develops a conceptual model of perception based on children's lived experiences. The findings demonstrate that children actively interpret their acoustic environment



by identifying sound sources, describing their characteristics, and expressing affective and bodily responses. It suggests that children employ a range of behavioral adaptation strategies to modify and shape the acoustic environment around them. The study also highlights children's preferences for classroom soundscapes that support clarity, concentration, and a balanced social atmosphere.

The findings of this study aligned with those of Visentin et al. [4], who similarly investigated the ideal soundscape of primary school children and highlighted their preference for music and natural sounds. The conceptual framework developed in this study overarches the framework for school soundscape proposed by Kurukose Cal et al. [9] by including children's direct perspectives. Kurukose Cal et al. [9] highlights the preferences of teachers and acoustic experts in prioritizing speech clarity, effective hearing, and restorative acoustic conditions. This helps in identifying the polarity between acoustic needs in adults and children's experiential preferences, suggesting that an optimal classroom soundscape may require a process of negotiation between teachers and students, recognizing both as active agents with distinct, and at times differing, behavioral aspects and acoustic preferences that should be considered while designing.

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