

## Article

# The Impact of the Soundscape on University Life: Critical Music Education as a Tool for Awareness and Transformation

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**Abstract:** This study explores the impact of soundscapes on the emotional and academic experiences of preservice teachers enrolled in music education courses within an elementary education degree program. It focuses on the framework of critical music education and future teachers' reflections on soundscapes, emphasizing the importance of fostering awareness of the acoustic environment. The study uses a mixed-methods approach, including a quasi-experimental design and group discussions, to assess the emotional and cognitive effects of listening to natural versus urban soundscapes among preservice teachers ( $n = 89$ ). The results indicate that listening to natural soundscapes significantly increases positive emotions and reduces negative emotions, while urban soundscapes have the opposite effect. Group discussions revealed that university campus soundscapes, often dominated by traffic and construction noise, negatively impacts students' socialization, relaxation, and concentration, potentially affecting their academic performance. The study suggests incorporating soundscape awareness and critical listening into music education programs to foster both environmental and social awareness among students and to support the development of critical consciousness in future educators and citizens.



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**Keywords:** soundscape; critical music education; university; student teachers; emotion

## 1. Introduction

In recent decades, there has been growing interest in studying how academics and students perceive the university environments in which they operate (Beringer & Adomßent, 2008; Gough & Scott, 2007; Lopera et al., 2019; Speake et al., 2013). In Spain, since the 1990s, university distribution models have undergone significant changes, favoring a peripheral campus model located outside urban centers to accommodate increasing student enrollment and the expansion of educational institutions (Bellet, 2011). Although the term campus suggests a setting removed from city centers, Spanish university campuses are highly concentrated with students, leading to significant pedestrian and vehicular traffic that impacts urban infrastructure (Martí et al., 2019).

Despite efforts by the Ministry of Education to modernize the Spanish university system, there remains a pressing need to advance toward a more sustainable model. This includes developing environmentally conscious campuses through the implementation of targeted programs and practical initiatives (Delgado, 2017). One key aspect of this sustainability is the creation of acoustic environments that support academic activities and enhance the well-being of the university community (Liang et al., 2024). This is particularly

relevant given that noise pollution has been shown to impair attention, memory, and academic performance in language and mathematics (Klatte et al., 2017; Papanikolaou et al., 2015; Thompson et al., 2022). Moreover, it can negatively affect the central nervous system, increasing the risk of mental health conditions such as depression, anxiety, and suicidal behavior, as well as contributing to behavioral problems in children and adolescents (Hahad et al., 2025; Li et al., 2022; Lim et al., 2018). In contrast, exposure to natural soundscapes has been associated with psychophysiological restoration (Bai & Zhang, 2024), including reductions in anxiety and stress (Gilmour et al., 2024) and improvements in overall health and positive affect (Buxton et al., 2021).

In this context, music education emerges as a powerful tool for fostering such transformation. As a discipline that encourages reflection on sound and acoustic environments, it plays a crucial role in developing both awareness and transformative agency among students. The former is understood as the development of an informed, reflective, and critical understanding of the acoustic environment and its social, cultural, and ecological implications. The latter, transformation, refers to the capacity to imagine, design, and implement meaningful changes in the sonic environment through pedagogical, artistic, or civic actions. By fostering these processes, critical music education encourages auditory sensitivity and empowers individuals to become active agents of change.

Specifically, adopting the concept of soundscape (Botella & Ramos, 2024; Hurtado et al., 2022, 2023; Schafer, 1977; Tejada et al., 2023) from a critical perspective enables the development of auditory sensitivity, allowing individuals to identify different acoustic environments, assess their impact on various human activities, and devise transformative strategies for their surroundings. From this standpoint, this study aims to address the following research questions:

RQ1: What is the emotional impact of the soundscape on preservice teachers enrolled in music education courses?

RQ2: How do preservice teachers perceive their campus soundscapes, and how do these affect their university experience?

RQ3: What pedagogical strategies can be implemented to address noise pollution in the music classroom?

### 1.1. The Impact of Noise on University Life

Environmental noise poses a significant health risk, affecting over 100 million people in the European Union and resulting in the loss of more than 1.6 million healthy life years in Western Europe due to road traffic noise alone (WHO, 2018). This phenomenon disrupts communication and contributes to stress, sleep disturbances, and hearing damage (Vásquez, 2015). To mitigate these effects, the European Union and its member states have implemented environmental policies, such as Law 7/2002 in the *Generalitat Valenciana* (2002), which aims to protect both public health and environmental quality. These policies go beyond ensuring tolerable urban environments—they seek to create healthy spaces that promote social interaction and overall well-being. Among these spaces, university campuses should be designed to foster community engagement and support the holistic development of their members (German-González & Santillán, 2006; Martínez-Usarralde et al., 2017).

The university experience is meant to facilitate personal growth, the formation of lasting friendships, academic success, and access to resources and activities that promote civic engagement, ultimately contributing to a more just and equitable society (Echeverría et al., 2021). However, J. L. Gutiérrez (2020) has shown that university students tend to experience limited interpersonal interactions in both communal and academic spaces—an issue linked to the poor environmental quality of many university campuses. Furthermore,

students exposed to noise pollution often develop inattentive behaviors in class, negatively affecting their reading and language skills (Rauf et al., 2015). Studies have established a negative correlation between academic performance and noise levels in educational settings, showing that excessive noise diminishes learning abilities (Ozer et al., 2014). Prolonged exposure to noise also interferes with communication, causes hearing loss, disrupts sleep, induces tinnitus, increases stress levels, and contributes to cognitive fatigue, hypertension, ischemic heart disease, and balance disorders (Ibrahim, 2023). Ultimately, the physical attributes of learning environments and their spatial design directly influence students' perceptions and experiences (González-Zamar & Abad-Segura, 2020).

Given these challenges, universities must undergo essential transformations in the design, structure, and organization of learning spaces to accommodate innovative methodologies and meet evolving physical, environmental, technological, and social needs (Barrett et al., 2017; González-Zamar & Abad-Segura, 2020). In response, urban planners, architects, and acoustic experts are working together to design parks, green spaces, and natural areas that enhance health by reducing stress, promoting positive emotions, mitigating negative ones, improving attention capacity, and alleviating mental fatigue (Fiebig et al., 2020; Medvedev et al., 2015). Integrating natural elements into educational environments not only strengthens students' connection with their surroundings and fosters an appreciation for the natural world but also bridges the gap between classroom learning and real-life applications, contributing to their personal, emotional, and social development (Hurtado & Botella, 2023). Additionally, incorporating natural design elements—such as vegetation and abundant natural light—has been shown to lower stress levels while enhancing productivity and creativity. Similarly, spatial designs that encourage social interaction and community participation can reinforce a sense of belonging and promote overall social well-being (Escamilla, 2024).

### *1.2. Critical Music Education and Reflection on the Soundscape*

Driven by a concern about the growing issue of noise pollution, the Canadian composer Murray Schafer coined the concept of soundscape in the 1970s, with the aim of fostering critical listening to the acoustic environment and raising awareness of the ways in which sounds reflect and influence culture, society, and the environment (Schafer, 1975, 1977). A soundscape is composed of a diverse array of sounds originating from biological, geophysical, and anthropogenic sources that vary across space and time, reflecting essential ecosystemic processes and human activities (Pijanowski et al., 2011). This concept is closely linked to that of the acoustic community, which refers to a group of individuals or elements within a specific environment that share a common sonic space or are interconnected through their perception and experience of surrounding sounds (Pisano, 2015; Truax, 1984). The sounds produced by various sources occupy space and contribute to human integration within it, often in subconscious ways. In this regard, the concept of the soundscape serves as a valuable tool for fostering sonic awareness and education, as it makes the ways in which sound influences a community and its everyday activities audible and tangible. The sounds that shape a given soundscape can play a pivotal role in individuals' perceptions of place, influencing how they navigate and engage with their surroundings (Carles, 2007).

More specifically, engaging with soundscapes through the lens of a critical music education provides students with the tools to perceive, analyze, and critically interrogate the sonic environments that define their daily experiences (Botella, 2020; Song et al., 2024). While traditional music listening is often grounded in an aesthetic perspective that emphasizes contemplative, passive, abstract, and intellectual experiences of a set of musical pieces (Bradley, 2012; Westerlund, 2006), this approach is connected to a movement of pedagogical renewal in music education that shifts from the idea of music as a collection

of pieces to the active, reflective, and creative exploration of sound itself, with particular emphasis on the immediate environments (Paynter & Aston, 1970; Schafer, 1976). Thus, it fosters a range of skills that encourage deeper, more conscious listening and an expanded understanding of the cultural, social, and environmental implications of sound.

For instance, students can develop active listening skills by identifying and reflecting on the dominant sounds in their communities or urban spaces (Corbett, 2016). They can also cultivate critical awareness of their sonic surroundings by analyzing the interplay between natural and artificial sounds and their broader social and environmental consequences (Cárdenas-Soler & Martínez-Chaparro, 2015; Edwards, 2023; Hurtado & Botella, 2023). Furthermore, critical engagement with soundscapes can foster an appreciation for sonic diversity across cultures, genres, and traditions, challenging the dominance of Western musical paradigms and incorporating traditionally marginalized or overlooked sounds (Pauta, 2019; Rodríguez, 2017).

In addition, critical music education can heighten awareness of noise pollution by encouraging analysis of soundscape quality and the development of strategies to improve the well-being of acoustic communities (Jan, 2014; S. X. G. Gutiérrez, 2018). It can also prompt students to question social norms and power structures embedded in sound, exploring how auditory environments relate to issues of identity, authority, and collective memory (Baker et al., 2020; Shayegh et al., 2017). Moreover, the creative production of soundscapes—whether through composition, field recordings, or sonic interventions in public spaces—offers opportunities for deeper reflection on the relationship between sound and space, as well as the ways in which sound can be manipulated to convey specific messages or evoke particular emotions (Akbari, 2016; Botella & Ramos, 2024). Ultimately, this critical reflection on sonic environments facilitates the categorization, conceptualization, and evaluation of sound materials, fostering a problematizing perspective on the intersections between music and society (Marín-Liébaná et al., 2021; Navarro, 2017).

## 2. Materials and Methods

This study employed a mixed-methods approach. On the one hand, a repeated-measures design was implemented, incorporating two experimental conditions with pretest and posttest assessments for each. On the other hand, focus groups were conducted to gain deeper insight into the results.

### 2.1. Sample and Context

This study involved 89 preservice teachers enrolled in an elementary education teaching degree at a Spanish public university, who participated in a quasi-experimental design (Table 1). The average age of the participants was 19.23 years ( $SD = 2.39$ ), with 80.85% identifying as female. Additionally, 26.70% had received some form of specialized musical training. Of the total sample, 28 students (85.71% female) participated in four discussion groups. The students were drawn from three different class groups—two generalist cohorts and one specializing in music education. The university campus is located near two major avenues with heavy traffic flow, experiences high student density, and lacks green spaces. Prior to data collection, informed consent was obtained from all participants, ensuring that their participation was voluntary, anonymous, and confidential. They were fully informed about the study's objectives, the use of their data, and their right to withdraw at any time without consequences.

**Table 1.** Sample description.

| Variable                     | Category          | <i>n</i> | %      |
|------------------------------|-------------------|----------|--------|
| Gender                       | Female            | 72       | 80.85% |
|                              | Male              | 17       | 19.15% |
| Age                          | 18–19 years       | 54       | 60.67% |
|                              | 20–21 years       | 28       | 31.46% |
|                              | >21 years         | 7        | 7.87%  |
| Specialized musical training | Yes               | 30       | 26.70% |
|                              | No                | 59       | 66.29% |
| Group                        | Music education   | 30       | 33.71% |
|                              | General education | 59       | 66.29% |

## 2.2. Data Collection Instruments

The quasi-experimental design utilized the Positive and Negative Affect Schedule (PANAS) questionnaire (Watson et al., 1988), translated into Spanish by Sandín et al. (1999). This instrument consists of 20 items divided into two categories based on emotion type: 10 assess positive emotions, and 10 assess negative emotions. Responses are rated on a five-point Likert scale ranging from “very slightly or not at all” (1) to “extremely” (5). PANAS measures the intensity of emotions or feelings experienced by participants at the time of assessment, rather than evaluating personality traits. Studies have validated both the internal consistency and structural validity of this scale, such as those conducted by Fincham and Linfield (1997) and Watson et al. (2000), which highlight its strong internal consistency and expected factorial structure based on the Kaiser criterion for sample adequacy. However, these studies also acknowledge the scale’s temporal and situational nature, as its results depend on the specific context and timing of administration.

For the discussion groups, a semi-structured interview protocol was developed to explore students’ experiences with the soundscape in greater depth. The protocol included five key questions: (1) How did you feel when listening to the two soundscapes? (2) How would you describe the soundscape(s) of your university campus? (3) Do any of the soundscapes you listened to resemble those present on your campus? (4) How do you think the soundscape(s) of your campus might influence your university experience? (5) Do you believe that fostering acoustic awareness and sensitivity to soundscapes would be beneficial in elementary education? Why? If so, how would you incorporate it into your teaching practice?

## 2.3. Procedure

First, a training session was conducted to introduce the concept of soundscapes within the framework of music education. Following this, the quasi-experimental design was implemented separately for each class group. Each participant completed the PANAS questionnaire (pretest), listened to a 10 min recording of a soundscape (experimental condition), and then completed the same questionnaire again (posttest). Two different recordings were used: (1) a natural soundscape featuring white noise from water and wind, along with occasional animal sounds such as birds (frequency range: 20–7000 Hz; volume level: 55–71 dB); and (2) an urban soundscape featuring traffic noise and crowd sounds (frequency range: 27–3800 Hz; volume level: 44–72 dB). Each participant experienced both conditions on different days, completing the questionnaire a total of four times. To control for order and sequence effects, a counterbalancing approach was applied: two groups listened to the natural soundscape first, while the remaining group started with the urban soundscape.

After the quasi-experimental phase, students were invited to volunteer for the discussion groups. A total of 32 students expressed interest and were randomly assigned to one of four groups. However, four participants did not attend the scheduled sessions, resulting in two groups of eight members and two groups of six members. The discussion groups were conducted online via Zoom. Each session lasted approximately 30 min, during which the predefined questions were presented, and an open discussion was facilitated. The sessions were recorded, transcribed, and analyzed.

#### 2.4. Data Analysis

Both quantitative and qualitative methods were used to analyze the collected data. The repeated-measures quasi-experimental design was analyzed using SPSS 28 software, applying ANOVA, a robust statistical test for samples exceeding 30 participants, even when normality assumptions are not met (Blanca et al., 2017; Sullivan et al., 2016). Two composite variables—positive emotions and negative emotions—were created by calculating the mean scores of the respective individual emotion items. Additionally, gender and musical training were used as between-subject grouping factors. Post hoc comparisons were conducted using paired-sample *t*-tests. Effect sizes were calculated for both tests, using eta-squared for ANOVA and Cohen's *d* for paired *t*-tests. For the qualitative analysis, Atlas.ti 8 software was used to generate thematic networks based on the transcriptions of the discussion groups. The process began with an initial phase of open coding, during which the most relevant text segments were identified and assigned descriptive labels. These codes were then grouped into broader categories or themes in order to uncover patterns across participants' narratives. Finally, the Atlas.ti 8 network tool was used to visualize the relationships between codes and categories. This approach enabled a systematic organization of the data and facilitated the identification of latent meanings within the participants' discourse.

### 3. Results

The following section presents the results obtained from the quasi-experimental design and the discussion groups.

#### 3.1. Quasi-Experimental Design

Regarding the composite variable of positive emotions, the factorial repeated-measures ANOVA revealed a significant main effect of time (Table 2,  $F(1, 88) = 43.11$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.33$ , indicating that scores differed significantly between the pretest and posttest. The interaction between time and condition was also significant,  $F(1, 88) = 109.76$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.55$ , suggesting that the effect of time on scores varied depending on the condition (Figure 1). Post hoc comparisons (Table 3) indicated that listening to the natural soundscape led to a significant increase in scores from pretest to posttest,  $t(1, 88) = 3.84$ ,  $p < 0.001$ ,  $d = 0.72$ , whereas listening to the urban soundscape resulted in a significant pre-post decrease,  $t(1, 88) = -12.71$ ,  $p < 0.001$ ,  $d = 0.68$ . Additionally, posttest scores were significantly higher following exposure to the natural soundscape compared to the urban soundscape,  $t(1, 88) = 7.91$ ,  $p < 0.001$ ,  $d = 0.91$ .

As shown in Table 4, all positive emotions demonstrated a significant time\*condition interaction with large effect sizes, except for active ( $\eta_p^2 = 0.13$ ) and alert ( $\eta_p^2 = 0.11$ ). Post hoc comparisons revealed that all positive emotions significantly decreased following exposure to the urban soundscape, while attentive, enthusiastic, inspired, and proud increased after listening to the natural soundscape (Table 3). Furthermore, all positive emotions, except for active and alert, exhibited significantly higher scores after the natural soundscape compared to the urban soundscape. All significant post hoc differences had large effect sizes ( $d > 0.8$ ).

**Table 2.** Main effects and interaction effects.

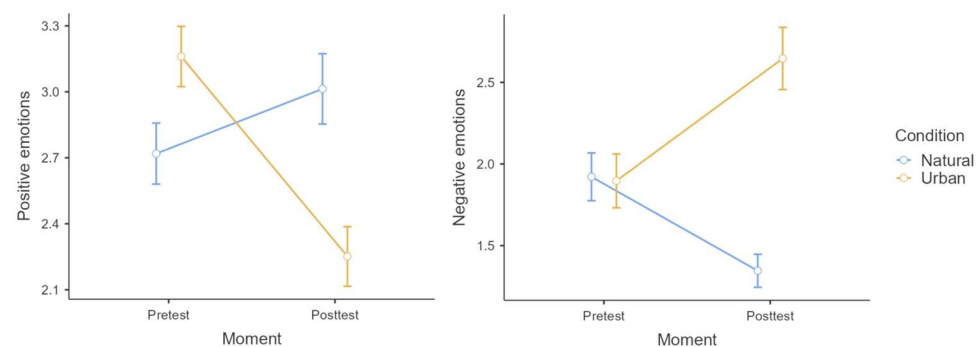
|              | Moment  |          |            | Condition |          |            | Mom*Cond |          |            |
|--------------|---------|----------|------------|-----------|----------|------------|----------|----------|------------|
|              | F(1,88) | <i>p</i> | $\eta_p^2$ | F(1,88)   | <i>p</i> | $\eta_p^2$ | F(1,88)  | <i>p</i> | $\eta_p^2$ |
| Positives    | 43.11   | <0.001   | 0.33       | 4.90      | 0.029    | 0.05       | 109.76   | <0.001   | 0.55       |
| Active       | 31.61   | <0.001   | 0.26       | 5.94      | 0.017    | 0.06       | 13.01    | <0.001   | 0.13       |
| Attentive    | 13.92   | <0.001   | 0.14       | 8.53      | 0.004    | 0.09       | 104.56   | <0.001   | 0.54       |
| Determined   | 11.34   | 0.001    | 0.11       | 0.62      | 0.013    | 0.07       | 54.53    | <0.001   | 0.38       |
| Alert        | 28.68   | <0.001   | 0.25       | 14.02     | <0.001   | 0.14       | 10.35    | 0.002    | 0.11       |
| Enthusiastic | 15.08   | <0.001   | 0.15       | 13.24     | <0.001   | 0.13       | 112.57   | <0.001   | 0.56       |
| Strong       | 21.13   | <0.001   | 0.19       | 2.30      | 0.133    | 0.03       | 36.88    | <0.001   | 0.30       |
| Excited      | 13.55   | <0.001   | 0.13       | 13.21     | <0.001   | 0.13       | 54.55    | <0.001   | 0.38       |
| Inspired     | 6.44    | 0.013    | 0.07       | 7.98      | 0.006    | 0.08       | 64.48    | <0.001   | 0.42       |
| Interested   | 24.11   | <0.001   | 0.21       | 15.27     | <0.001   | 0.15       | 60.62    | <0.001   | 0.41       |
| Proud        | 3.10    | 0.082    | 0.03       | 8.40      | 0.005    | 0.09       | 48.73    | <0.001   | 0.36       |
| Negatives    | 1.95    | 0.166    | 0.02       | 87.77     | <0.001   | 0.50       | 128.59   | <0.001   | 0.59       |
| Upset        | 1.19    | 0.278    | 0.01       | 83.32     | <0.001   | 0.49       | 62.64    | <0.001   | 0.42       |
| Jittery      | 1.53    | 0.219    | 0.02       | 36.83     | <0.001   | 0.30       | 59.46    | <0.001   | 0.40       |
| Hostile      | 0.56    | 0.454    | 0.01       | 8.60      | 0.004    | 0.09       | 18.36    | <0.001   | 0.17       |
| Distressed   | 2.05    | 0.091    | 0.03       | 30.78     | <0.001   | 0.26       | 37.81    | <0.001   | 0.30       |
| Scared       | 10.38   | 0.002    | 0.11       | 44.85     | <0.001   | 0.34       | 51.61    | <0.001   | 0.37       |
| Ashamed      | 1.87    | 0.174    | 0.02       | 45.39     | <0.001   | 0.34       | 138.99   | <0.001   | 0.61       |
| Guilty       | 1.63    | 0.205    | 0.02       | 4.86      | 0.03     | 0.05       | 10.14    | 0.002    | 0.10       |
| Irritable    | 0.29    | 0.594    | 0.00       | 68.36     | <0.001   | 0.35       | 63.04    | <0.001   | 0.42       |
| Afraid       | 2.95    | 0.089    | 0.03       | 69.70     | <0.001   | 0.44       | 100.25   | <0.001   | 0.53       |
| Nervous      | 0.2     | 0.887    | 0          | 21.67     | <0.001   | 0.2        | 38.31    | <0.001   | 0.30       |

**Table 3.** Post hoc comparisons.

|              | Pretest-Posttest<br>Natural |          |          | Pretest-Posttest<br>Urban |          |          | Posttest Natural-Posttest Urban |          |          |
|--------------|-----------------------------|----------|----------|---------------------------|----------|----------|---------------------------------|----------|----------|
|              | t(1,88)                     | <i>p</i> | <i>d</i> | t(1,88)                   | <i>p</i> | <i>d</i> | t(1,88)                         | <i>p</i> | <i>d</i> |
| Positives    | −3.84                       | <0.001   | 0.72     | 12.71                     | <0.001   | 0.68     | 7.91                            | <0.001   | 0.91     |
| Active       | 0.69                        | 0.245    | 1.37     | 7.12                      | <0.001   | 1.12     | 0.58                            | 0.56     | 1.45     |
| Attentive    | −4.89                       | <0.001   | 1.24     | 10.55                     | <0.001   | 1.14     | 8.81                            | <0.001   | 1.32     |
| Determined   | −2.74                       | 0.004    | 1.08     | 7.48                      | <0.001   | 1.11     | 6.60                            | <0.001   | 1.19     |
| Alert        | 0.88                        | 0.192    | 1.21     | 5.88                      | <0.001   | 1.21     | −1.05                           | 0.297    | 1.52     |
| Enthusiastic | −4.02                       | <0.001   | 0.98     | 9.88                      | <0.001   | 0.98     | 9.25                            | <0.001   | 1.10     |
| Strong       | −1.81                       | 0.037    | 1.06     | 7.82                      | <0.001   | 1.00     | 5.55                            | <0.001   | 1.13     |
| Excited      | −3.16                       | 0.001    | 0.84     | 6.95                      | <0.001   | 1.11     | 7.03                            | <0.001   | 1.19     |
| Inspired     | −4.58                       | <0.001   | 1.16     | 7.42                      | <0.001   | 1.26     | 7.49                            | <0.001   | 1.36     |
| Interested   | −2.51                       | 0.007    | 1.06     | 9.23                      | <0.001   | 1.02     | 7.46                            | <0.001   | 1.32     |
| Proud        | −4.50                       | <0.001   | 0.97     | 6.50                      | <0.001   | 1.00     | 5.92                            | <0.001   | 1.40     |
| Negatives    | 10.99                       | <0.001   | 0.49     | −6.88                     | <0.001   | 1.03     | −13.03                          | <0.001   | 0.94     |
| Upset        | 6.67                        | <0.001   | 0.81     | −5.62                     | <0.001   | 1.26     | −9.46                           | <0.001   | 1.38     |
| Jittery      | 7.96                        | <0.001   | 0.97     | −6.78                     | <0.001   | 1.63     | −12.55                          | <0.001   | 1.45     |
| Hostile      | 4.45                        | <0.001   | 0.83     | −6.00                     | <0.001   | 1.52     | −8.89                           | <0.001   | 1.40     |
| Distressed   | 5.76                        | <0.001   | 1.16     | −5.62                     | <0.001   | 1.57     | −11.59                          | <0.001   | 1.48     |
| Scared       | 4.06                        | <0.001   | 0.78     | −4.37                     | <0.001   | 1.38     | −7.54                           | <0.001   | 1.27     |
| Ashamed      | 3.82                        | <0.001   | 0.78     | −1.18                     | 0.121    | 1.08     | −3.64                           | <0.001   | 1.11     |
| Guilty       | 4.86                        | <0.001   | 0.68     | −1.91                     | 0.03     | 1.17     | −5.05                           | <0.001   | 1.13     |
| Irritable    | 8.89                        | <0.001   | 1.05     | −7.93                     | <0.001   | 1.50     | −12.33                          | <0.001   | 1.42     |
| Afraid       | 5.78                        | <0.001   | 0.77     | −3.69                     | <0.001   | 1.26     | −6.83                           | <0.001   | 1.72     |
| Nervous      | 6.78                        | <0.001   | 1.11     | −5.14                     | <0.001   | 1.67     | −10.20                          | <0.001   | 1.60     |

**Table 4.** Descriptive statistics.

|              | Pretest (Nat.) |      | Pretest (Urb.) |      | Posttest (Nat.) |      | Posttest (Urb.) |      |
|--------------|----------------|------|----------------|------|-----------------|------|-----------------|------|
|              | M              | SD   | M              | SD   | M               | SD   | M               | SD   |
| Positives    | 2.71           | 0.66 | 3.16           | 0.65 | 3.01            | 0.75 | 2.25            | 0.64 |
| Active       | 2.62           | 1.09 | 3.27           | 0.94 | 2.52            | 1.00 | 2.43            | 1.03 |
| Attentive    | 2.44           | 0.90 | 3.11           | 0.96 | 3.08            | 1.03 | 1.84            | 0.88 |
| Determined   | 2.78           | 0.91 | 3.13           | 0.93 | 3.09            | 1.00 | 2.26            | 0.91 |
| Alert        | 2.51           | 1.15 | 3.31           | 1.11 | 2.39            | 1.03 | 2.56            | 1.13 |
| Enthusiastic | 2.66           | 0.90 | 3.02           | 1.03 | 3.08            | 0.96 | 2.00            | 0.83 |
| Strong       | 2.70           | 1.04 | 3.07           | 1.02 | 2.90            | 1.10 | 2.24            | 0.85 |
| Excited      | 2.79           | 0.94 | 3.00           | 0.97 | 3.07            | 0.96 | 2.18            | 0.83 |
| Inspired     | 2.42           | 1.00 | 2.89           | 1.01 | 2.98            | 1.01 | 1.90            | 0.88 |
| Interested   | 3.09           | 0.83 | 3.33           | 0.89 | 3.37            | 0.88 | 2.33            | 0.95 |
| Proud        | 3.20           | 0.91 | 3.47           | 1.04 | 3.66            | 1.09 | 2.79            | 1.15 |
| Negatives    | 1.92           | 0.69 | 1.90           | 0.78 | 1.35            | 0.48 | 2.65            | 0.91 |
| Upset        | 2.08           | 1.01 | 2.13           | 1.11 | 1.51            | 0.81 | 2.89            | 1.19 |
| Jittery      | 2.13           | 1.13 | 2.08           | 1.18 | 1.31            | 0.65 | 3.25            | 1.30 |
| Hostile      | 1.58           | 0.94 | 1.54           | 1.00 | 1.19            | 0.54 | 2.51            | 1.30 |
| Distressed   | 2.25           | 1.24 | 2.43           | 1.15 | 1.54            | 0.91 | 3.36            | 1.26 |
| Scared       | 1.58           | 0.98 | 1.62           | 0.94 | 1.25            | 0.61 | 2.26            | 1.29 |
| Ashamed      | 1.58           | 0.89 | 1.56           | 0.95 | 1.27            | 0.69 | 1.70            | 0.96 |
| Guilty       | 1.62           | 0.94 | 1.64           | 1.06 | 1.27            | 0.67 | 1.88            | 1.12 |
| Irritable    | 2.45           | 1.16 | 2.06           | 1.07 | 1.46            | 0.85 | 3.31            | 1.28 |
| Afraid       | 1.64           | 0.91 | 1.60           | 0.93 | 1.17            | 0.57 | 2.09            | 1.26 |
| Nervous      | 2.29           | 1.25 | 2.31           | 1.29 | 1.49            | 0.83 | 3.22            | 1.36 |

**Figure 1.** Interaction plots.

Regarding the composite variable of negative emotions, a significant main effect of condition was found (Table 2),  $F(1, 88) = 87.77, p < 0.001, \eta_p^2 = 0.50$ , indicating that scores differed significantly between the natural and urban soundscape conditions. The interaction between time and condition was also significant,  $F(1, 88) = 128.59, p < 0.001, \eta_p^2 = 0.59$ , suggesting that the effect of time varied depending on the condition (Figure 1). Post hoc comparisons (Table 3) indicated that listening to the urban soundscape led to a significant increase from pretest to posttest,  $t(1, 88) = -6.88, p < 0.001, d = 1.03$ , while exposure to the natural soundscape resulted in a significant pre-post decrease,  $t(1, 88) = -0.049, p < 0.001, d = 0.49$ . Similarly, posttest scores were significantly higher following exposure to the urban soundscape compared to the natural soundscape,  $t(1, 88) = -13.03, p < 0.001, d = 0.94$ .

As presented in Table 2, all negative emotions exhibited a significant time\*condition interaction with large effect sizes, except for “embarrassed” ( $\eta_p^2 = 0.13$ ). Post hoc comparisons revealed that all negative emotions significantly decreased after exposure to the natural soundscape, whereas all negative emotions—except for ashamed and guilty—increased following exposure to the urban soundscape (Table 3). Furthermore, all negative

emotions had significantly higher scores after the urban soundscape compared to the natural soundscape. All significant post hoc differences had large effect sizes ( $d > 0.8$ ).

No significant differences were found based on gender or musical training, as shown in Tables 5 and 6.

**Table 5.** Main effects and interaction effects based on gender.

|           | Moment*Gender |          |            | Condition*Gender |          |            | Mom*Cond*Gend |          |            |
|-----------|---------------|----------|------------|------------------|----------|------------|---------------|----------|------------|
|           | F(1,88)       | <i>p</i> | $\eta_p^2$ | F(1,88)          | <i>p</i> | $\eta_p^2$ | F(1,88)       | <i>p</i> | $\eta_p^2$ |
| Positives | 4.55          | 0.036    | 0.05       | 0.27             | 0.603    | 0.00       | 0.24          | 0.629    | 0.00       |
| Negatives | 0.73          | 0.395    | 0.01       | 0.42             | 0.838    | 0.00       | 2.02          | 0.159    | 0.02       |

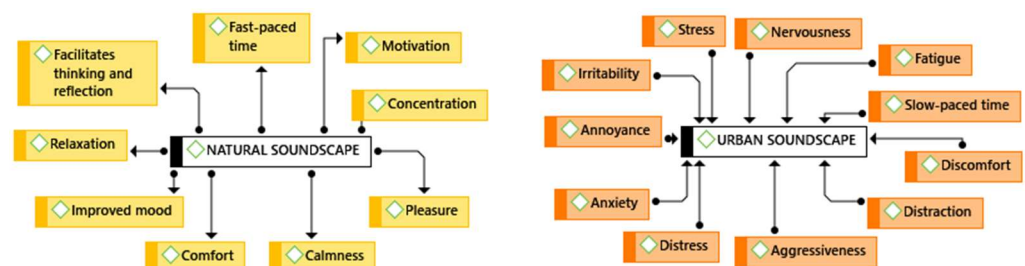
**Table 6.** Main effects and interaction effects based musical training.

|           | Moment*Music |          |            | Condition*Music |          |            | Mom*Cond*Mus |          |            |
|-----------|--------------|----------|------------|-----------------|----------|------------|--------------|----------|------------|
|           | F(1,88)      | <i>p</i> | $\eta_p^2$ | F(1,88)         | <i>p</i> | $\eta_p^2$ | F(1,88)      | <i>p</i> | $\eta_p^2$ |
| Positives | 0.16         | 0.690    | 0.00       | 1.14            | 0.288    | 0.01       | 0.69         | 0.409    | 0.01       |
| Negatives | 0.55         | 0.462    | 0.01       | 0.21            | 0.651    | 0.00       | 0.49         | 0.487    | 0.01       |

### 3.2. Focus Groups

The focus groups delved into the emotions experienced during the listening of both soundscapes, the identification of soundscapes on the university campus by the participating students, their impact on university life, and the implications for teaching in elementary education.

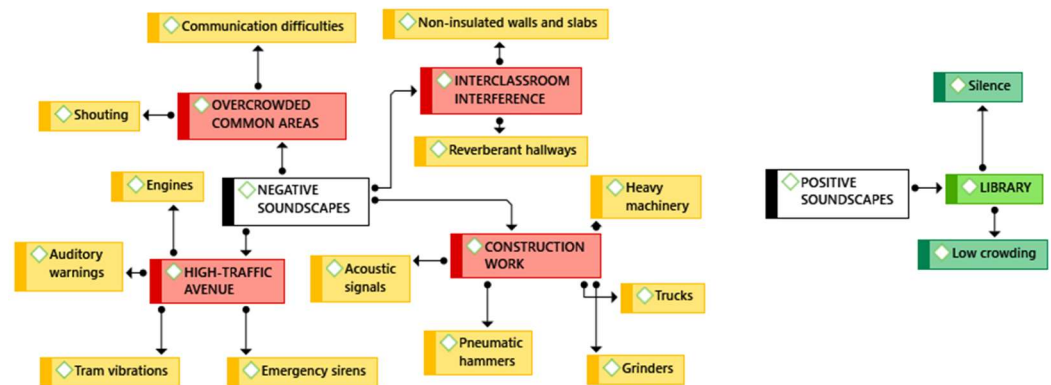
Regarding the listening experience of both soundscapes, the participants agreed on the emotions they had experienced (Figure 2). The natural soundscape, for example, was associated with positive sensations such as pleasure, relaxation, tranquility, and comfort; with a state conducive to reflection, concentration, and motivation; and with the perception that time passes more quickly. In contrast, the urban soundscape was linked to higher levels of stress, nervousness, overwhelm, and aggression; with a more distracted and irritable mental state; and with the sensation that time passes more slowly. Additionally, some participants noted that the soundscape in which they had spent their childhood and adolescence influenced their listening experience. Specifically, those who had lived in a rural setting were more sensitive to the urban soundscape than those who had grown up in a large city.



**Figure 2.** Emotions perceived during listening.

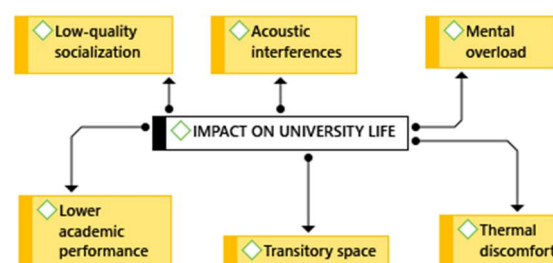
Regarding the soundscapes identified on the university campus, most of them were classified as negative (Figure 3). First, the high-density avenue adjacent to the main lecture hall was a source of noise from motor vehicles, emergency sirens, and loud warning signals, as well as a low-frequency rumble caused by the passing tram. Second, the study was conducted while long-term construction work was taking place on the campus grounds.

This resulted in continuous noise from heavy machinery, trucks, grinders, pneumatic drills, and various acoustic signals. Third, participants identified overcrowded areas with high conversation volumes that hinder communication, as well as interference between classrooms due to the presence of reverberant hallways and partition walls lacking necessary sound insulation. In contrast to these soundscapes, the participants noted that the library offers a positive soundscape, as its limited traffic creates a quiet space.



**Figure 3.** Soundscapes identified on the campus.

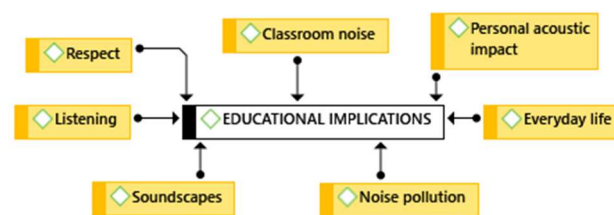
Regarding the impact of soundscapes on university life, the participants focused on the negative aspects resulting from noise-saturated spaces (Figure 4). They indicated that overcrowding in classrooms and common areas negatively affects the quality of socialization, as environmental noise hinders communication and encourages isolation through the use of headphones to reduce noise exposure. This situation also prevents mental rest, creating a sense of saturation that makes relaxation difficult and that increases cognitive fatigue. As a result, the participants reported experiencing reduced concentration and higher levels of anxiety, factors that can affect their academic performance. Furthermore, the lack of suitable spaces discourages students from staying on campus to study or eat, leading some to relocate to a nearby university campus in search of better conditions. Thus, their campus, rather than being an environment that encourages engagement and learning, is perceived as a transit space. In the classroom, they pointed out that external noise prevents windows from being opened, which, during hot weather when the cooling system is not functioning, leads to thermal discomfort, once again resulting in greater difficulties with attention and concentration. On the other hand, acoustic interference in the classroom forces instructors to raise their voices to be heard, which can foster a perception of greater authoritarianism and further hinder content comprehension.



**Figure 4.** Impact of soundscapes on university life.

Regarding the implications that soundscapes can have on elementary education teaching, the participants agreed that soundscapes should be introduced into the classroom. The main goal they highlighted was to contribute, through various teaching proposals (Figure 5), to the development of a more aware and critical citizenship concerning noise pollution.

They emphasized the importance of fostering respect for others by raising awareness of one's own noise, including voice tone and the use of electronic devices. It was suggested to maintain low noise levels in the classrooms to prevent their normalization, along with explicit awareness-raising on noise pollution and the introduction of the soundscape concept through debates. To achieve this, activities were proposed to assess the impact of noise and explore silence and active listening. Furthermore, it was emphasized that these actions should not be limited to isolated interventions but should be integrated into the everyday life of the educational institution. The need to experience different soundscapes through sound walks and sound identification was underscored, encouraging reflection on their impact on the environment. Finally, it was considered essential to involve students in transforming these soundscapes, promoting their active participation in improving the school's acoustic environment.



**Figure 5.** Implications for elementary education teaching.

#### 4. Discussion

This study examined the emotional impact of the soundscape on students enrolled in music education courses within an elementary education degree program, exploring their perceptions of the sound environments on their university campus, the influence these environments have on their academic experience, and their potential impact on their future teaching practices. First, it was found that, in general, listening to the natural soundscape enhanced positive emotions and decreased negative ones. Conversely, listening to the urban soundscape led to an increase in negative emotions and a decrease in positive ones. Specifically, the natural soundscape particularly intensified concentration, enthusiasm, inspiration, and pride, while the urban soundscape notably increased agitation, aggression, distress, irritation, and nervousness, which is consistent with [Fiebig et al. \(2020\)](#) and [Medvedev et al. \(2015\)](#). All these results were corroborated in the focus groups, where additional categories such as pleasure, relaxation, tranquility, comfort, and motivation were associated with the natural soundscape, and stress, overwhelm, and distraction with the urban soundscape. This aligns with the study by [Speake et al. \(2013\)](#), who conducted a survey at Liverpool Hope University, where most students valued and used green spaces, considering them important for the university's image and as an essential element of the campus, enhancing their quality of life.

Likewise, according to [Liang et al. \(2024\)](#), restorative environment theory suggests that certain spaces, especially those connected to nature, have the ability to restore cognitive and emotional resources depleted by stress and mental fatigue. These environments are characterized by inducing feelings of calm and facilitating sustained attention with minimal effort. For example, natural soundscapes serve as restorative stimuli that reduce anxiety, promote relaxation, and enhance both emotional well-being and the ability to concentrate. When applied to the educational context, this suggests that integrating natural sounds or acoustically comfortable environments into learning spaces can generate positive emotions, such as calmness and motivation, while also supporting cognitive processes. In this way, not only does students' emotional state improve, but their learning outcomes may also be enhanced.

It is important to highlight that sustained attention and reading or auditory comprehension can be directly affected by the sound environment (Klatte et al., 2017; Papanikolaou et al., 2015; Thompson et al., 2022). Noisy or acoustically unfavorable environments can disrupt the ability to maintain prolonged concentration and even interfere with meaning-making during cognitively demanding tasks such as reading, writing, or problem-solving (Ozer et al., 2014; Rauf et al., 2015). Conversely, pleasant and natural sound environments support continuous concentration, enhance auditory speech perception, and allow deeper comprehension of academic content (Fiebig et al., 2020; Medvedev et al., 2015).

The participants rated the soundscapes of their campus negatively, pointing to a high-density avenue next to the lecture hall, long-term construction within the campus, overcrowded common spaces, reverberant materials, and classroom interference. Thus, the negative perception of the university environment creates a negative view of the institution and social interactions within it, generating discomfort and disconnection, ultimately affecting the development of interpersonal bonds and leading to social isolation (Ozer et al., 2014). As a solution to this issue, other studies advocate for a transformation of universities to adapt their learning spaces to meet the demands of new methodologies and the current physical, environmental, technological, and social conditions (Barrett et al., 2017; González-Zamar & Abad-Segura, 2020). More specifically, González-Zamar and Abad-Segura (2020) argue that, in recent decades, the need to transform learning spaces, particularly in higher education, has become evident in order to adapt them to new methodologies, technologies, and social demands. Proper design positively impacts students' motivation, emotional well-being, and social interaction. Factors such as color and aesthetic appearance directly contribute to motivation and social relationships. Similarly, the presence of light and spatial flexibility support learning. Overall, there is broad consensus that the classroom environment is one of the most important factors influencing student learning outcomes.

Similarly, Barrett et al. (2017) state that lighting, appropriate temperature, and air quality levels are fundamental environmental measures that influence the students' ability to concentrate in the classroom. For this reason, school building regulations in the United Kingdom have included design requirements to ensure that classrooms meet minimum standards in these environmental aspects. In addition, natural elements or views of the natural environment have been shown to enhance cognitive function.

The preservice teachers indicated that the soundscapes detected on their campus had a negative impact on their university experience. In terms of academic performance, they reported mental saturation and continued cognitive fatigue, including low concentration, high anxiety, thermal discomfort, and difficulties in hearing their professors. This is consistent with previous research suggesting that prolonged exposure to noise pollution in educational settings impairs students' academic performance and causes health issues (Rauf et al., 2015; Ozer et al., 2014). In this sense, one of the most significant effects of noise is on students' learning and concentration levels, causing a lack of speech intelligibility and poor focus during lessons (Ibrahim, 2023). The students also noted poor socialization due to the lack of spaces conducive to lingering after classes, which coincides with Escamilla (2024) and J. L. Gutiérrez (2020).

All participants agreed that the topic of soundscapes should be introduced into the primary school classroom to foster critical thinking regarding noise pollution, aligning with the pedagogical proposals of Navarro (2017) and Schafer (1975, 1976, 1977). In this regard, the idea of listening critically to the environment and using sound as a pedagogical tool is not new. Schafer (1976) emphasized the importance of developing listening skills through creative and reflective engagement with the surrounding soundscape. His work laid the foundations for what would later become known as acoustic ecology, advocating for a form of musical education rooted in environmental awareness and sensitivity to

sound. Similarly, [Paynter and Aston \(1970\)](#) proposed structured classroom activities that encouraged students to explore sound as an artistic and experiential element. Their work promoted the idea that children should be given opportunities to create and reflect on sound in imaginative and exploratory ways, recognizing sound as a medium of expression and understanding.

Building on this foundation, more recent research continues to emphasize the importance of cultivating sonic awareness in educational contexts. In this line, [Jan \(2014\)](#) identified exposure to noise in Malaysia as a problem for music educators across educational levels, as the state of environmental noise affected students in areas such as quality of life, contextual education, environmental awareness, aesthetic education, and health. Other researchers also emphasize the need to teach children to listen to the soundscape from an early age, as it is a constituent part of any community and is constantly transforming due to technological and environmental factors ([Corbett, 2016](#); [S. X. G. Gutiérrez, 2018](#)).

Additionally, the students proposed actions such as raising awareness of one's own noise, reducing volume levels in classrooms, engaging in silence-related activities, organizing sound walks to identify specific soundscapes, and providing tools to improve the acoustic environment surrounding students. This is consistent with studies that argue that soundscape topics should be an experiential, habitual practice in music education classrooms ([Cárdenas-Soler & Martínez-Chaparro, 2015](#)). Other studies highlight the need to increase awareness of environmental sounds among both students and their teachers ([Akbari, 2016](#)). Furthermore, some research introduces technology into music education to raise awareness among elementary and secondary students about their sound environment, thereby opening new spaces for creativity and transformation ([Tejada et al., 2023](#)).

Moreover, critical music education could raise awareness of noise pollution through the analysis of soundscape quality and the development of measures to improve the quality of acoustic communities. For example, [Edwards \(2023\)](#) demonstrated that a shift towards sound in music education spaces has the potential to catalyze a creative critical awareness among secondary and undergraduate music students. [Botella and Ramos \(2024\)](#) conducted research in a secondary music education classroom, where students created soundscapes of ecosystems threatened by climate change and human action. The results showed an enhancement of environmental competence among the students. Other studies assert that taking a music education course promotes richer sound perceptions and clearer emotional associations with sound, and that these improvements could enhance critical perception of the soundscape ([Song et al., 2024](#)).

Thus, the soundscape emerges as a key component within music education, oriented toward educational and social transformation. In this context, research projects at universities encourage comprehensive and conscious musical listening to the soundscapes of the students' environments ([Hurtado & Botella, 2023](#)). Other projects aim to foster recreational spaces, from an acoustic ecology perspective, prioritizing control of environmental pollution on the campus ([Pisano, 2015](#); [S. X. G. Gutiérrez, 2018](#)).

Finally, it is worth emphasizing that the soundscape can serve as a transformative tool in educational and social settings beyond music education. For example, in natural sciences, soundscapes could be integrated into sustainability and ecology education, helping students understand the relationship between sound and environmental health. In history, the evolution of the soundscape over time could be explored to show how changes in human environments have influenced societies. From a diversity perspective, students could learn how different cultures create distinct soundscapes based on their interactions with the environment. In art, soundscapes could be represented through drawing, using various techniques to capture the emotions conveyed by each one. Similarly, in theater, plays could be created to address the issue of acoustic pollution and its impact on communities. Finally,

in mathematics and physics, students could explore how sound intensity is measured, connecting real-world applications with the scientific principles behind sound.

## 5. Conclusions

This study reveals the significant influence of the soundscape on the academic and emotional experiences of students enrolled in music education courses within an elementary education degree program. It was observed that the natural soundscape promotes greater concentration, satisfaction, and well-being, while the urban soundscape generates negative emotions that affect concentration, the quality of socialization, and academic performance. These sound perceptions directly impact students' mental and physical health, supporting previous research on the negative effects of noise pollution in educational settings. Furthermore, the results suggest that integrating soundscape work into music education could be an effective tool to raise students' awareness of the importance of their acoustic environment, foster critical listening, and reduce the adverse effects of noise. The students' proposals, such as promoting noise awareness and implementing educational activities related to soundscapes, open new possibilities for improving the quality of the educational environment. In this context, the incorporation of the soundscape into educational programs could not only transform the academic experience but also contribute to the development of critical awareness in future educators and citizens.

Some concrete examples of how critical listening can be incorporated into the real curriculum include: (1) analyzing soundscapes through activities in which students identify and reflect on the different sonic environments around them; (2) engaging in active listening, where students explore musical pieces or sounds from various cultures, styles, or historical periods; (3) developing acoustic environment design projects, in which students propose ways to optimize classroom acoustics and soundscapes to improve attention and reduce stress; and (4) observing and recording how everyday sounds influence their emotional state and concentration throughout the day. In this way, students not only develop their critical listening skills, but also gain awareness of how soundscapes impact both their learning environment and daily lives.

Although this research has focused on teacher training in primary education, the findings could have relevant implications at other educational levels, such as secondary or higher education. In these contexts, where academic stress and cognitive demands are greater, improving the sound environment could play a significant role in students' mental health, social interactions, and the learning process. Exploring the application of these strategies across different levels and disciplines could open up new opportunities for creating healthier, more inclusive educational environments that are aware of the surrounding soundscape.

This study presents some limitations that should be considered when interpreting the results. The sample, consisting of university students with a homogeneous profile in terms of age and sociodemographic characteristics, may limit the generalizability of the findings. Additionally, the low percentage of male participants in the sample could affect the broader applicability of the results. Moreover, while the integration of the soundscape into music education is suggested to be beneficial, the study focuses on elementary education, meaning the applicability of the results to other academic disciplines or educational contexts may be limited. Furthermore, another aspect to consider is the durability of the effects of the soundscape. For example, in educational settings, it is likely that the positive effects of a soundscape, such as stress reduction and improved concentration, will persist for as long as students are exposed to it. However, if this ideal acoustic environment is not maintained in the long term, the benefits may decrease or disappear. Adaptation to sound also plays an important role; people may become accustomed to certain sounds, losing the restorative

impact they initially provided. In urban environments, the restorative effects of a natural soundscape may be harder to sustain due to the constant presence of unwanted noises, such as traffic or construction.

This study opens new avenues for exploring how the soundscape influences the teaching and learning process, particularly in the context of initial teacher training. It is recommended that future research investigates how integrating the soundscape into the music education curriculum could affect students' academic and emotional perceptions, as well as their ability to teach more reflectively about the acoustic environment. Furthermore, future studies could examine strategies to mitigate the negative effects of noise in educational settings, such as creating spaces that enhance the natural soundscape and foster critical listening.

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