

Article

Development of Social and Environmental Competences of Teachers in Training Using Sound and Visual Landscape

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Abstract: The soundscape was used as the basis of the research carried out by the Teaching Faculty of the Universitat de València Spain. The research focused on two aspects: (i) study the relationship between environmental sounds and emotions as a base to promote environmental awareness; and (ii) analyze the usefulness as an educational resource for the development of social and environmental competences of teachers in training. Thus, a didactic sequence was designed using 360° virtual recordings of natural and human landscapes in which participants described sound and visual elements that they associated with a range of emotions. Moreover, participants identified environmental problems and reflected on the usefulness of the sound and visual landscape in the acquisition of social and environmental competences. Both qualitative and quantitative methods were used in this study and 327 teachers participated in the training. The findings show the observation of sound and visual elements can facilitate the understanding of environmental problems. The natural soundscape was associated with positive emotions, while more industrial or urban landscapes were associated with negative emotions. This can affect on people's well-being. Moreover, the participants had a good perception of the development of their social and environmental competences, and considered that the activity promoted the transfer of knowledge and developed argumentative and critical capacities. This approach offers the opportunity to create learning environments contextualized in the landscape that facilitate the connection of scientific and artistic disciplines from an experiential perspective. It is essential to continue studying and implementing educational strategies that promote the integration of theory and practice.

Keywords: sound and visual landscape; interdisciplinary education; environmental and social competences; teacher training; environmental education; art education



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1. Introduction

Recent social changes have modified educational systems and require new teaching concepts to develop and train committed, free, and critical citizens able to achieve a sustainable world [1]. According to UNESCO [2], these educational changes have been in several dimensions: (i) teaching and learning environments that make possible exploratory, transformative action-oriented learning; (ii) teaching results that guarantee the development of civil and social competences such as critical thinking, decision making, and collective responsibility; and (iii) teaching people to participate and play active roles in solving real problems and creating a fairer, peaceful, inclusive, and sustainable world. One of education's most important functions is to help improve environmental awareness, and promoting citizens' commitment to the environment can change environmentally harmful lifestyles [3]. Teacher training in environmental competencies derives from the need to reorient new curricula to sustainability. Thus, the integration of sustainability education in initial teacher training will ensure the promotion of sustainability among future citizens [4].

Recent research reveals that teachers in initial training lack sufficient environmental competences with which to educate their future students [5]. From this perspective, it is necessary to train future teachers to develop their teaching in the framework of innovative, flexible, active, and highly technological learning spaces. Furthermore, the role of the teachers as social stakeholders that facilitate the connection of education and citizenship with the objectives of sustainable development should be emphasized [6]. This study aims to explore the relationship between natural sounds and emotions as a basis for promoting environmental awareness, and to analyze its didactic possibilities in teacher training. This field of research is very recent and connects emotional education, music, education, and environmental education.

In this transformation of the education process, having knowledge and knowing how to do things (concepts and procedures) should not be the only things considered, but also personal qualities (knowing how to behave) related to decision making and exchanging information as the basis of future professional performance of the teachers [7,8]. Thus, education activates changes, revolutions, and it renovates teaching to improve the teaching-learning process using the many resources of formal and informal education. Moreover, this learning should take place in motivating contexts that facilitate collaboration and experimentation [9]. In this sense, the contextualized activities in the environment can facilitate the relationship between theory and practice [10,11]. When interpreting and analyzing outdoor phenomena, theoretical and conceptual contents are combined with the knowledge experienced by the students [12].

Outdoor learning plays an important role in applying learning to real-life situations and helps students to be in tune with the environment, making a large contribution to their personal, emotional, and social development [13,14]. Sensorial perception of the landscape gives us information on its components, such as their shapes, sizes, proportions, colors, and sounds, and goes beyond the physical and forms part of the invisible perception in which the sentiments and experiences form an indivisible part of the landscape. In this way, contextualized educational practices in the environment involve the combination of three dimensions: education in the environment, education about the environment, and education in favor of the environment [15,16]. This can contribute to the acquisition of values and attitudes that favor a change to responsible and sustainable behaviors towards the environment [17].

At the emotional level, experiences in nature can promote learning and improve student's attention, stress levels, self-discipline, interest, and enjoyment of learning [18]. Out-door classrooms improve welfare and class participation [19,20], providing a quieter and safer learning context [18]. On the other hand, according to Soga and Gaston [21], missing interaction with the environment can make emotional perceptions related to health and welfare difficult. In this regard, social competence is connected to personal and collective welfare, and requires an understanding of the way in which people can obtain the optimal physical and mental health status both for themselves, their families, and their immediate social context, and be aware of how a healthy lifestyle can contribute to it. However, outdoor activities are not always possible due to time constraints, travel costs, and organizational difficulties. By implementing a 360-degree virtual simulation using Virtual Reality, landscapes can be recreated and thus provide a complementary resource to outdoor activities. These techniques enable immersion into previously recorded scenarios, enabling observation, hearing, and an understanding of the processes and identification of the environmental problems that are present [22]. VR is a digital simulation of the surroundings in which users can become completely immersed [23]. In VR surroundings, they can move around and see in all directions and interact with objects, providing the pupils with a strong sense of being in the simulated space [24,25]. According to the review carried out by Hew and Cheung [26], VR was mainly used in the fields of arts, health, and the environment. Mikropoulos and Natsis [24] carried out a review between 1999 and 2009 and concluded that the general characteristics of VR included the principles of constructivism; experiential, contextual, and collaborative learning, spatial representation,

and engagement. As for the limitations, Kavanaugh et al. [27] identified limitations related to cost, difficulty of use, and problems of motion sickness during immersion. Virtual field trips (VFTs) can improve accessibility and can introduce the “nature of fieldwork” by involving students. Virtual field trips can also familiarize the teachers with fieldwork and encourage them to offer physical field trips to their students [28,29].

The debate on creating societies more in contact with the environment highlights theories such as acoustic ecology, setting concepts of the relationship between individuals and the environment, and between communities and their surroundings. There is an undoubtedly intense relationship between the ecological or natural and artistic concepts of the landscape such that their perception includes sensations and emotions related to its welfare and admiration. In their work, artists and ecologists express a wish to know the elements of which it is composed and their interrelationships. Sensorial perception of the landscape gives us information on its components, such as their shapes, sizes, proportions, colors and sounds, and goes beyond the physical and forms part of the invisible perception in which the sentiments and experiences form an indivisible part of the landscape. Art generates emotions, and as Swanwick [30] has justified: “the arts as forms of knowledge can be just as efficient as any other method of human discourse and are also able to contribute to the development of the mind at the conceptual level”. The studies by Sun et al. [31] suggest that audible and visual perceptions interact with each other.

The soundscape or acoustic ecology [32] makes it possible to study the effects of the surroundings we listen to and the characteristics of the behavior of those who live there [33]. The concept of soundscape, the name first given to it by the Canadian R. Murray Schafer, is based on the defense of the sound-silence binomial as a value in itself and as a source of creativity [34,35]. This concept is shared by composer and improviser Pauline Oliveros, who describes what she calls her deep listening [36], emphasizing that the art of listening is a necessity [37]. The soundscape is the total acoustic environment belonging to a place. Its design is not from above or outside but from inside, and is achieved by stimulating a group to learn to listen with critical attention to the sounds around them [38]. From these, a deeper study of the sound is derived (its timbre, height, intensity, and duration). Our sensorial relationship with the environment makes us realize that the landscape includes sounds; a study of the soundscape promotes its multidisciplinary character, and integrates the scientific, empirical, and artistic perceptions necessary to include its concept, development, and utility in present society as a strategy for exploring the increasing need of present-day societies to find more receptive and tolerant environments that can be obtained by a clear awareness of the relationships in our territory. The soundscape can construct ways to preserve, reappropriate, and learn about the environment. It is based on a project of sensitization, observation, and analysis, and a diagnosis that provides methodological strategies to understand acoustic activity in the transformations that constantly occur in the territory. The study of the landscape using acoustic landscapes is part of the holistic vision of the environment and considers both artistic and scientific perspectives. Supported by this multidisciplinary plane, reflections on the nature of sound, the materiality of its influence, and its potential in environmental and musical education as an environmental conservation and sensitization strategy are proposed [36]. From the perspective of cognitive psychology, listening is related to the audible perception understood as selective attention [39], and as such, we must help to educate our listening [40]. This means creating an educational plan for students to relate more fully to the sounds in the environment [32], both to know themselves and understand them better [41], i.e., promote awareness of our soundscape [42,43], or what Schafer [34,35] calls cleaning the ears. Promoting the need to auditorily sensitize students [35], or what Hemsy de Gainza [44] calls an open pedagogical model that harmoniously and functionally integrates musical creativity and listening. It could even happen, as Pelinsky [45] has suggested, that we do not hear the sounds in our everyday soundtrack “because we are used to hearing them [and because] we have matched sounds with silence, or with what we believe to be silence”. Critically listening to the soundscape helps to develop an awareness of sound and identify and classify its diverse

qualities. Given its polysemic character, as a result of its classification, it can problematize the many implications of sound. According to Botella [36], when a sound transmits an emotion, whatever it may be, it has become sound art, and so it is very important to create sensorial expectations based on auditory perceptions, since the soundscape will become an emotional landscape [46].

Acoustic environments with different soundscapes can be acoustically comfortable or uncomfortable from the point of view of students' emotions and their learning process. Poor acoustic environments have been shown to negatively disrupt students' learning and affect their performance [47]. When a soundscape is unpleasant, people may experience discomfort and adverse effects, such as difficulty concentrating and problems related to their general health and quality of life [48]. High levels of background noise and activity levels in classrooms can be detrimental to verbal communication and learning [47,49], and high noise levels have large impacts on children's cognitive functioning [48]. In addition, continuous exposure to chronic noise can lead to poor academic performance, motivation, and concentration [50].

Moreover, according to Moscoso et al. [51], soundscape analysis can help to understand social-ecological interactions. In their studies, they analyzed the emotional associations with everyday sounds and their implications for the conservation of environments. Thus, soundscapes constitute a direct connection between natural systems and humans [52]. In this way, soundscape is a useful tool for understanding the impact of environmental disturbances on humans and their effects on human well-being [53].

Social and environmental education can thus be an essential dimension in people's formation, and so also in teachers' competences, in connection with which the following questions arise: Is it possible to develop the social and environmental competences of teachers training through sensory experiences with the landscape? What could be the role of soundscape perception in understanding the environment and associated emotions?

This research is part of a larger project whose main objective is to analyze the usefulness of the sound and visual landscape as a strategy to develop the teaching competences that promote social and pro-environmental attitudes. For this, approaches were made to the sound and visual landscape using virtual immersion in some everyday natural and/or human environments, and deepened the relationship between the landscape elements and emotions, and how these experiences can promote environmental awareness. The general objective was then divided into three secondary aims:

1. Identify the elements in the sound and visual landscape establishing emotional associations that reflect the human-environmental relationship (OBJ1);
2. Analyze the environmental problems with an emphasis on acoustic contamination to reflect on the need to promote environmental awareness in teacher training (OBJ2);
3. Assess the usefulness of the soundscape and landscape as a strategy to develop the social and environmental competences during teacher training (OBJ3).

2. Materials and Methods

2.1. Participants

The study was carried out in 2017–2019 on 327 teachers under training in the 3rd and 4th years of the Primary Education Teacher's Degree course at the Universitat de València. A non-probabilistic sampling was carried out with a convenience sample by selecting the groups of the specialties related to the content of the activity. Participation was voluntary and took place during class sessions. No incentive or reimbursement was given for their participation. At the beginning of the activity, the participants were informed about the study and its objective, and their agreement was requested before proceeding with the activity. The students were from three specialties: Information and Communications Technology ($n = 132$), Science and Maths ($n = 163$), and Musical Education ($n = 32$). Of the total students, 64.5% were women and 35.5% were men. Table 1 gives their details, distribution by year, and specialties.

Table 1. Distribution of participants.

Course	Itineraries	Participants <i>n</i> = 327	
		Female <i>n</i> = 211	Male <i>n</i> = 116
3	Information and Communications Technology	48	42
3	Science and Mathematics	54	24
4	Science and Mathematics	62	23
4	Information and Communications Technology	29	13
4	Musical Education	18	14

2.2. Procedure

The experience was conducted in three sessions for a total of 4 h: immersion was carried out in the classroom in the first two sessions (3 h) and reflection was carried out online in the third session (1 h). All activities were carried out individually. Before starting the sessions, the activities were explained and the materials for the descriptions and data collection (questionnaires and notebook) were handed out. The study was divided into three phases:

1. Preparation and validation of teaching material. The study team prepared the virtual immersion experience from a series of 360° recordings of natural and/or human surroundings, using Samsung VR and GoPro Fusion cameras, plus the necessary editing software (Gear 360 Action Director, GoPro Fusion Studio 1.3, and GoPro VR Player 3.0). The videos were shared through a freely accessible Youtube channel (Table 2). The landscapes selected for 360° recording were done by applying several criteria:
 - Representative of Spanish Eastern Mediterranean landscapes;
 - Diversity of the elements they composed with emphasis on the sound and visual components;
 - Diversity of soundscapes bearing in mind the following characteristics of sound: character, dynamics, nuances, accentuation and articulation, form and structure, texture, rhythm, and melody.

In total, 26 landscapes were recorded in 360° formats of three types according to the degree of intervention or presence of humans: 12 natural landscapes (4 on the coast and 8 mountain), 7 rural, and 7 urban landscapes.

The research team compiled an activities notebook to identify and describe the elements included in the soundscapes and landscapes, and for reflections on the relationships between the soundscapes, emotions, and environmental problems. Before the immersion experience, the materials were validated by the Delphi technique.

2. Virtual immersion. At the beginning of the activity, all the videos were shown. Subsequently, participants were asked to select and analyze a scene from each type of landscape. The immersion was performed using a mobile device and virtual reality glasses. During the virtual immersion, participants identified sound and visual elements, expressed emotions associated with the landscape, and identified environmental issues with an emphasis on noise pollution problems. To do so, they completed a series of contingency tables and an ad hoc qualitative questionnaire;
3. Reflection. At the end of the experience, reflections were made on the possible use of soundscapes and landscapes in the educational context to develop social and environmental competences during teacher training.

Table 2. 360° landscapes used for virtual immersion.

Type of Landscape	VR Collection Link	Scenery
Coastal	"https://bit.ly/3rBkMtA" (accessed on 20 March 2023)"	Beach Beach with shells Dunes Beach with seaweed
Mountain	"https://bit.ly/3JOmKwN" (accessed on 20 March 2023)"	Daisies Life on ground Tree Herbaceous Turche Cave Pinewoods Clover Cork trees
Rural	"https://bit.ly/3KU9qsa" (accessed on 20 March 2023)"	Vegetable garden Walk through fields Fruit trees Almond trees Vines Olive trees Orange trees
Urban	"https://bit.ly/3EojW8t" (accessed on 20 March 2023)"	Traffic Medieval market Religious festival District Fireworks Garden Kids' amusement park

2.3. Measures

A case study was conducted using a quasi-experimental mixed-methods approach in which quantitative and qualitative elements were used in different stages. In this way, the research question was better understood and the quantitative data could be supported by the qualitative data [54]. The participants completed a notebook of activities containing two tables: one to identify sounds and their acoustic properties, and another in which they described their emotional perceptions during the immersion in the soundscape. They also reflected on environmental problems (with emphasis on acoustic contamination) and their relationship to healthy and unhealthy environments.

Questions of the qualitative questionnaire:

- Q1 Indicate the name of the visualized landscape and justify your choice;
- Q2 Identify the origin of the sonorous and visual elements of the landscape;
- Q3 Describe the emotions that the landscape produces in you;
- Q4 Indicate the environmental problems present in the landscape.

At the end, a rating scale was used to assess the degree to which the activity had contributed to the acquisition of the environmental and social teaching competences. For it, 9 competences were included, which were extracted from the official curriculum of the Primary Education Teaching Degree of the Universitat de València. Through a 10-point scale (where 10 is the maximum level of competence achieved), the participants indicated the level of achievement they had reached after carrying out the activity. The reliability of the instrument was measured by Cronbach's alpha, obtaining a value of 0.79.

To reduce social desirability, participants completed the questionnaires (quantitative and qualitative) voluntarily and anonymously. The tests were computer-based to maintain as neutral an environment as possible.

2.4. Data Analysis

A Delphi study was performed by a panel of 15 experts selected for their extensive teaching experience (>10 years) in music and the natural and social sciences in different educational stages (9 university teachers of training teachers, 3 secondary education teachers, and 3 from primary education teachers). The study was divided into three consultation rounds: the first consisted of existing teaching materials and an evaluation questionnaire with generally formulated questions. A summary of the responses to the first round was compiled and the materials were updated following the suggestions made. In the second and third rounds, the questions were increasingly specific and were related to design aspects and the usefulness of the teaching materials [55]. The suggestions and contributions made by the experts were then incorporated into the materials.

The qualitative questionnaires were analyzed using the phenomenographic approach. According to Miles et al. [56], in the qualitative approach, data collection focuses on the participants' perspectives and points of view (emotions, priorities, experience, and meanings) and has an inductive foundation because it explores and describes reality to generate theoretical knowledge.

3. Results

The following are the results of the research organized in five blocks: Section 3.1 selection of the landscape; Section 3.2 description of the sound and visual elements; Section 3.3 emotional perception of the landscape; Section 3.4 environmental problems; and Section 3.5 perception of the trainee teachers on the usefulness of the sound and visual landscape as an educational resource, and its contribution to the development of social and environmental competences. Sections 3.1–3.3 show the results corresponding to objective 1; Section 3.4 shows the results corresponding to objective 2; and Section 3.5 shows the results corresponding to objective 3.

3.1. Selection of Landscapes

A total of 584 landscapes were viewed during the immersion phase. The chosen coastal landscapes, in declining order: Beach (54.5%), Shells on the Beach (27.2%), Dunes and seaweed (<10%). In the mountains, the sceneries: Daisies (29.4%), followed by Life on the ground and in trees (17.6%), Turche Cave (11.8%), and Herbaceous, Pinewoods, Clover, Cork trees (<10%). In those from rural areas, the most frequently selected was a Walk through the Vegetable garden (29.4%), followed by Vegetable field and Fruit trees (17.6%), Almond and Orange trees (11.8%), Vines and Olive trees (<10%). Finally, in urban sceneries, District was the most often selected (25%), followed by Traffic and Park (20.2%), Medieval market (15.3%), Fireworks (10.0%), Garden and Religious festival (<10%).

The participants explained their choice by emphasizing that the recordings from the ground or on plants offer an unusual perspective and allow them to observe the behavior of living beings without intervening in the environment, since the camera is integrated with the elements of the scene. In addition, it should be noted that the aesthetics of the landscape is an important factor in the selection. As for urban landscapes, they relate them to daily actions.

3.2. Description of Sound and Visual Elements

Tables 3–6 describe the audible and visual features in each type of landscape, classified by the categories included in the studies by Bones et al. [57] and Hurtado et al. [16], composed of three categories and seven sub-categories: nature, animals, plants, and biotic elements. Human types were voices and music. Technological were industry and homes.

Table 3. Description of sounds and visual elements in the coastal landscape.

Category of Element	Sub-Category of Element	Sounds	Visual Elements
Nature	Animals	Birds	Seagulls
	Plants	--	Palm trees, reeds, seaweed
	Biotic	Wind, water, waves	Waves, shells, sand
Human	Voices	Voices	People
	Music	--	--
Technology	Industry	Cars	--
	Homes	--	Buildings, bridge

Table 4. Description of sounds and visual elements in mountain landscape.

Category of Element	Sub-Category of Element	Sounds	Visual Elements
Nature	Animals	Birds, insects	Insects, ants
	Plants	Leaves	Leaves, branches, trees, flowers
	Biotic	Wind, rain, water	Sun, rain, waterfall
Human	Voices	Conversation, laughing	People
	Music	--	--
Technology	Industry	Cars	--
	Homes	--	House, village

Table 5. Description of sounds and visual elements in rural landscape.

Category of Element	Sub-Category of Element	Sounds	Visual Elements
Nature	Animals	Birds, cows, dogs, insects	Snails, insects
	Plants	Leaves	Grass, trees, grass, oranges, snails, fruit trees, avocados, vegetables
	Abiotic	Wind	Sky, sun, mud, stones
Human	Voices	Voices, conversation, steps	People
	Music	--	--
Tecnology	Industrial	Cars, tractor, rotavators	Cars, rotavator, tractor
	Homes	--	Toolshed, country cottage

Table 6. Description of sounds and visual elements in urban landscape.

Category of Element	Sub-Category of Element	Sounds	Visual Elements
Nature	Animals	Dog, birds	Dog, pigeons
	Plants	--	Trees, garden, flowers
	Abiotic	Wind, rain	Sun, sky, clouds
Human	Voices	Children, laughing, voices, conversation songs, steps	Pedestrians, procession
	Music	Band	Musical instrument
Technological	Industry	Cars, bicycles, motorbikes, trams, fireworks	Traffic lights, tram, cars, bicycles, bicycle lane, road, lights
	Homes	Swings	Graffiti, building, flags, market stalls, swings

Sounds and visual elements predominated in the coastal and mountain landscapes above human and/or technological elements. In both, there was some interference from sounds from cars going along nearby roads. In the mountains, there were sounds made by humans in relation to their outdoor activities. Human elements were more present in

the rural landscape, in which human intervention is more necessary, accompanied by the noise of agricultural machines, including tractors and rotavators, toolsheds, and country houses. Human and technological elements predominated over natural elements in the urban landscape, plus music associated with festivals and popular culture (songs, bands, fireworks). In these soundscapes, the natural sounds were mostly from domestic animals (dogs), animals adapted to the urban environment (pigeons), and/or abiotic elements (wind and rain).

3.3. Emotional Perception of the Landscape

The emotional analysis grouped into two categories the expressions that described emotional states: pleasant and unpleasant. The natural environments (mountains and coast) and the rural had the most positive emotional perceptions (>92.5%). The most frequently used description was Tranquility (29.4%), followed by Calm, Relaxation, and Peace (14.5%, 13.2% and 10.8%, respectively). Joy and Happiness were also present in significant proportions (9.8% and 6.1%, respectively). The remaining sensations which were less frequently cited were: Switching off, Freedom, and Welfare ($\leq 5.0\%$).

The urban landscape revealed quite a low or zero level of welfare, and participants expressed terms such as Stress, Anxiety, and Sadness in reference to technological sounds from traffic and their acoustic contamination effect. In this regard, the participants reflected on the idea of urban environments being less healthy than natural and/or rural surroundings. Typical comments included: "A lot of noise in the city and this can affect people's health"; "It's better for the health to live in the country because there is a lot less acoustic contamination"; and "The sound level varies from place to place. We can reach the conclusion that there may be acoustic contamination in cities".

3.4. Environmental Problems

In coastal landscapes, participants described problems related to urban waste and the accumulation of decaying organic matter (algae). In mountain landscapes, most participants did not observe any environmental problems. In rural landscapes, participants mentioned water scarcity as the main problem, followed by the presence of waste and pests. Finally, in urban landscapes, light pollution was mentioned as the most important environmental problem. In all landscapes, participants described episodes of noise pollution as a consequence of vehicle traffic on nearby roads.

3.5. Teacher's Perception in Training of the Usefulness of Sound and Visual Landscapes as an Educational Resource to Develop Social and Environmental Competences during Teacher Training

The questionnaire responses gave the students' perceptions of the possibilities of soundscapes and landscapes as an educational resource for the acquisition of social and environmental competences in the curriculum of the Primary Teachers' Degree Course (see Table 7). The impact on learning was first analyzed based on the nine items related to these competences, which were evaluated by the participants on a scale of 0-10 (0 = total disagreement and 10 = complete agreement).

The responses indicate that the participants consider sound and visual landscapes to be a very useful educational resource for the development of social and environmental competences in teachers' training. As the most relevant aspects, they highlight the promotion of cooperative work and the approach to nature as a basis for promoting respectful and committed attitudes towards the environment, highlighting that these types of activities favor the relationship between nature and well-being [58,59]. These results lead us to think that the sound and visual landscapes are a teaching context of the first order for training future teachers, in agreement with the conclusions reached by Delgado [60]. On the other hand, it is observed that participants perceived a lower development of the general competences G4 and G12. Competence G4 is related to the ability to critically analyze situations and social questions that affect education. A low level of critical competences may be because it is a complex procedure that requires the development of many competences at

the same time. To this end, it is essential to continue implementing educational strategies that favor the integration of theory and practice. Regarding competence G12, it allows grouping information, and categorizing facts, behaviors, and/or events to be observed. The educational practice presented can promote these aspects, so it is necessary to continue promoting this type of activity, providing future teachers with greater autonomy to promote self-learning and the development of these competences.

Table 7. Usefulness of sound and visual landscapes as contexts for developing social and environmental competences in teacher training.

Official Curriculum of Primary Teacher Degree Course ¹ University of XXX.	Mean
CB3. Acquire the capacity to collect and interpret relevant data to give opinions that include reflections on relevant social, scientific, and ethical themes.	8.65
CG4. Critically analyze and incorporate currently relevant social questions that affect education at home or at school.	7.58
CG5. Promote cooperative and individual work.	8.95
CG6. Assume that the teaching function should be continuously improved and adapted to scientific, teaching, and social changes throughout life.	8.66
CG10. Work as a team with other professionals in planning sequences of organizing work in and out of the classroom.	8.54
CG12. Understand that systematic observation is a basic instrument for reflection on the practice and reality, as well as contributing to innovation and improvement of education.	7.92
CE27. Promote and collaborate in actions inside and outside school, organized by families, institutions, municipal authorities, or other institutions as regards citizens' training.	8.12
CE28. Collaborate with different sectors of the educational and social communities.	8.42
CE127. Promote interest in and respect for the natural environment and health through teaching projects.	9.62

¹ Basic (BC), general (GC), and specific competences (SC). Check from: "<https://go.uv.es/c7aDFan> (accessed on 5 June 2023)".

It has also been made clear that the teaching material used is a necessary complement for correctly carrying out the activity, since it provides the participants with the necessary information to identify and analyze sound elements by listening. It is important to have a well-designed program of activities that include questions for reflecting on the problems caused by acoustic contamination, health, and the emotions transmitted by the soundscape. It should also contain tables and activities to facilitate an analysis of the relationships among the elements in the landscape, and artistic and scientific disciplines. These tables and instructions should be clear and concise so as not to generate any doubts about their implementation.

Finally, more than 95% of the students reported themselves as very satisfied with the educational experience, and highlighted its curiosity, virtuality, and entertaining aspect as positive features.

4. Discussion

The present study aimed to analyze the usefulness of sound and visual landscapes as educational resources for the acquisition of social and environmental competences in teachers' training. Pre-recorded virtual landscapes were used as a tool to recognize sound and visual elements, and to facilitate an understanding of environmental problems and their impact on people's emotional health. Learning experiences in the natural environment were studied using a mixture of qualitative and quantitative methods combined with phenomenographic analysis. Participants described sounds that were organized into three categories

and seven sub-categories, following the system proposed by Bones et al. [57]. The analyses included a description of the types of sounds that occurred in each environment. Through the virtual experience, the teachers in training revised concepts of the sound and visual elements in the landscape [61], and responded to questions on the places they had visited. They thus had to deal with problems in the real world by collecting and interpreting data and reflecting on the evidence to reach conclusions, develop curiosity, and to ask themselves further questions, as suggested in the studies by Minocha et al. [62], and Pederson and Irby [25]. Thus, critical thinking is stimulated and people are prepared to participate effectively and constructively in social life through reflection, real-world problem solving, and emotional management [63]. Moreover, participants positively valued the usefulness of the sound and visual landscape for the development of social and environmental teaching competences [64], highlighting that it promotes the approach to nature and environmental commitment [16,58]. These results indicate that the soundscape and visual landscape can facilitate the understanding of the environment and have a pedagogical impact based on experiential learning, as shown in the studies of Lavie and Tal [13].

On the other hand, this research showed the relationship between soundscapes and emotions. This sensory approach to the environment positively influences the learning of contents and the development of social and environmental competences. Sounds and landscapes were associated with a variety of emotions, both positive and negative; some associations were universal: natural sounds were mainly associated with positive emotions, while mechanical and industrial sounds were linked to negative emotions [16,52]. In recent years, soundscape research has focused on studying how soundscape influences human well-being [65], and the effects of nature sounds on well-being [66,67]. The urban landscape has been shown to be the least healthy, and natural sounds are heard less due to the urban sonic environment that is filled with mechanical and engine sounds [68,69]. The soundscape can help to understand social-ecological interactions and is a direct connection between natural and human systems [52]. We agree with the findings of García de la Vega [70], who suggested that the environment should form a part of the educational process since the relationship between emotions and rigor increases creativity. The relationship between sounds and health is shown by the emotions perceived when experiencing the soundscape, showing the importance of using the acoustic environment as an educational resource for health and environmental education, as it focuses on the associated problems and acoustic contamination. The problems of acoustic contamination are analyzed from the perspective of urban environmental education; therefore, it is important to pay attention also to the social and cultural aspects, and not only to the ecological dimension [63]. The experience showed that the listening technique can be used as a teaching resource in interpreting the soundscape and that a type of “ear-cleaning” is required to improve our hearing capacity and discriminate clearly between the different elements as a technique that helps us to understand the sounds in the environment and their components.

The application of virtual reality can be combined with experiences in the real environment. In this sense, it would be interesting to compare the learning obtained in real and virtual environments. Some research suggests that learning results are similar to those of school outings [71].

In short, the results of the study suggest that sensory perception of the natural environment can be worked on in the classroom using quasi-realistic approaches through virtual immersion. This can facilitate the development of systems thinking, and increases the ability to analyze complex systems in different domains at different scales constituting an experiential and action-based learning framework, as described in the studies of Caniglia et al. [72] and Wiek et al. [73,74]. This soundscape and visual-based educational strategy integrates the characteristics described by Lambrechts and Petegem [75]: interactivity, participation, action, and research. The acquisition and evaluation of social and environmental competences require learning to be experiential, active, participatory, creative, problem-focused, and interdisciplinary.

5. Conclusions

This study is presented as part of a larger research process. The results show that an experimental and holistic approach to the soundscape helps teachers in training connect with reality, leads them to critically reflect on their perceptions, and generates positive emotions and social and pro-environmental attitudes. It also has shown the need for a change in the educational model towards the effective development of professional teaching competences and appropriate teacher training. Being aware of socio-environmental reality by means of sensorial stimuli of landscapes acoustic and visual can help to develop the capacity to evaluate and participate in decision making after analysis and reflection and so respond to social, environmental, and cultural problems logically, critically and rigorously, to finally obtain a sustainable world.

The results of the study indicate that it is essential to further explore and implement educational strategies that focus on the learners themselves, and promote the integration of theory and practice.

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