Acouscapes: A software for ecoacoustic education and soundscape composition in primary and secondary education

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Acouscapes is a software designed as a simple educational solution for the creation of soundscapes and their use in the composition of soundscape music in primary and secondary education. The software has slots in which the user must place the sounds that will make up the desired soundscape, allowing them to make different soundwalks by interacting with the graphic interface. Acouscapes allows the content of these soundscapes to be modified by means of sound and structural processing, and includes a recording function. This article aims to present the conceptual and educational foundations of Acouscapes, to describe the software technically and functionally, and to offer some applications of this software as a mediation artefact in educational processes.

1. INTRODUCTION

The concept of a *soundscape* has often been used ambiguously, pointing to both objectivity and subjectivity. A plethora of definitions of soundscape have arisen in the writings of authors from different disciplines. For example, Southworth (1967: 2) defines a soundscape as 'the quality and type of sounds and their arrangements in space and time'. Pijanowski, Farina, Gage, Dumyahn and Krause (2011: 1214) give another definition as 'the collection of biological, geophysical and anthropogenic sounds that emanate from a landscape and which vary over space and time reflecting important ecosystem processes and human activities'. Farina (2014: 3) defines it as 'an acoustical composition that results from the voluntary or involuntary overlap of different sounds of physical or biological origin' alluding the acoustic context produced. Finally, the International Standardization Organization (2014) defines it as 'the understanding of an acoustic environment as perceived or experienced and/or understood by a person or people, in context'. By extension, the term also addresses the representation, analysis and creation of the soundscapes themselves.

The study of soundscapes encompasses ecoacoustics, a main vein of scientific and artistic production. Ecoacoustics or acoustic ecology (Schafer 1969) emerged from cultural anthropology and is concerned with the development of auditory awareness and the meanings that the sounds of a given environment have for the people who live in it. The main idea for the creation of this software stems from an educational objective. In initial musical training, students enter with little awareness of the sound environment around them. It is enough to ask a random sample of people to make a list of the sounds they hear to verify this phenomenon. It is not a physiological problem; it is a characteristic of today's culture where visual stimuli prevail (Wrightson 2000). Hence the need for the learner to focus on the sound environment, to think about the meanings it has for him/her and to develop sensitivity towards acoustic hygiene. These elements were considered when designing Acouscapes,[1] an artefact designed to facilitate a closer approach to the soundscape.

To summarize, the point of this study is to develop a solution software to create soundscapes by capturing sounds from the environment, manipulating them, and finally creating electroacoustic compositions called soundscape compositions (Truax 2002) in primary schools. Acouscapes is an original, free and simply designed piece of software. The program provides an excellent opportunity for sound creation and improving acoustic awareness in both students and teachers. Thanks to its ease of use and the ability to incorporate sounds from the user's surrounding environment, sound creation, exploration and experimentation in soundscapes come naturally. So, Acouscapes could facilitate a twofold objective: approaching collaborative-musical creative processes in primary and secondary education and encouraging the students to be more concerned about the sounds around them.

1.1. Sound worlds around us: the soundscapes

Listening to our sound environments is one of the first experiences in our lives. It favours a development of sensitivity and curiosity towards the sound world that

[1]Software Acouscapes can be downloaded at: www.aglaya.org/descargas.

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doi:10.1017/S1355771823000201

surrounds us and allows us to interpret the world and appropriate it, building our own reality. The composer and educator Murray Schafer (1969) referred to the term *soundscape* as the set of sounds that surrounds human beings at any given moment. His research was directed towards awareness-raising through listening. He denounced the excessive increase of noise in the industrialised world and clearly pointed out the negative repercussions for the human being, such as depression, fatigue, stress and irritability.

Schafer (1969, 1977) suggested the concept of soundscape as the 'universal' composition of which everyone can be a composer. This bold concept was not intended as an alternative to music, but to the problems of noise. The concept of soundscape composition is linked to the emergence of the World Soundscapes Project (WSP) at Simon Fraser University in the early 1970s (Truax 2002). The aim of WSP was to enhance aural awareness of our soundscapes by inspiring and establishing a discourse that explores a sense of place through sound (Martin 2017).

Soundscape composition has evolved into a multitude of approaches, from representing acoustic environments with 'found sounds', to incorporating highly abstract sound transformations. The typology is often diverse but compositions ranging from sounds analogous to real-world experience can usually be found; listening from a fixed spatial perspective or moving through a series of connected acoustic spaces. Within compositions that make use of soundscapes one can find other structures that reflect the non-linear mental experiences of memory, dreams and free association, as well as the artificial sound constructions that are familiar and made possible by modern audio techniques of sound layering and embedding (Truax 2002).

Soundscape compositions are as different from each other as any other subgenre of electroacoustic music. Clearly, compositions created under the concept of soundscapes often stand on a continuum between found sounds and sounds captured in soundscapes, from which they draw inspiration, and abstract sounds with little or no reference to the real world (Martin 2017). Although sounds within soundscapes may contain processed sounds, these creations maintain certain links to sonic reality that serve as anchors for the listener, points of support for listening. In this sense, many composers like to create an imaginary world by processing sounds of diverse origins. As Westerkamp (2002: 54) mentions: 'The aesthetic musical language of the artist and the language of recorded sounds and soundscapes meet in the compositional process. And it is the meeting of the two "languages" and the way they balance each other that constitutes the creative challenge of soundscape composition.'

As Labelle (2010) states, sound follows a seemingly innocent trajectory that moves from the source to the listener, not forgetting all the surfaces, bodies or sounds it caresses. It is a story that agglutinates a lot of information and is fully charged with geographical, social, psychological and emotional energy. According to this author, a whole history and culture can be found within a sound; from its origin to its destination, sound can be the generator of a diverse range of experiences, as well as remaining specifically linked to a context, as an expressive, profound and prolonged figure of culture that, in addition, incorporates the dynamics of interference, noise and transgression.

If we combine Schafer's (1969) extreme sensitivity to the sonosphere or soundscape on the one hand, and Labelle's (2010) cultural concept on the other, we generate a homogeneous theoretical–empirical basis that allows us to specify artistic projects that raise awareness of sound transformation and its impact on our environment, as well as rediscovering the stories, life experiences and emotions that lie in the sounds that inhabit our sonic environments. All this amalgamation of sound and narrative will help to generate a more accurate idea of the self and the community, allowing us to understand where we come from, who we are, and what future we want to build.

However, there are two other factors that will allow us to understand the authors' intentions in designing the software presented in this article. On the one hand, there is the collaborative work in the collection of sounds to elaborate the soundscapes, which could facilitate a shared vision of the individual realities of groups of students and enhance their zone of potential cognitive growth. On the other hand, there is the use of software as a tool that could facilitate collaborative composition by modifying the soundscapes elaborated. These factors are presented in the following subsections.

1.2. Music learning and technology

People relate to other people through verbal interaction and through artefacts, and in so doing they construct meanings. The concept of mediation is key in the construction of each person's reality (Vygotsky 1978). Mediation relates to the ways in which artefacts act as links between people in this negotiated construction of reality. Technologies are artefacts that have no power in themselves, but rather their mediating capacity comes from the people who devise them (Bower 2019). They are unintentional intermediary objects used to collaborate in the construction of meaning between participants (Blumer 1986). Thus, meanings are the product of social interaction, primarily conscious communication, which becomes essential, both in the constitution of the individual and in the social production of meaning. People select, organise, reproduce and transform meanings in interpretative processes according to their expectations and purposes

https://doi.org/10.1017/S1355771823000201 Published online by Cambridge University Press

(ibid.). Thus, technology-mediated learning is a web made up of the role of the teacher, the pre-concepts, knowledge, expectations and practices of the learners, and the characteristics of the artefacts used. Elliott and Silverman (2015: 229) describe musical understanding as an intricate web of 'practical, situated, experiential, intuitive and embodied' knowledge, developed through embodied, enactive and interactive musical learning.

According to the preceding points, Acouscapes can act as an artefact that directly mediates the negotiation of meanings of the phenomena that different people are discussing, in this case, the elaboration of a soundscape or musical composition, and is intentionally applied by the teacher to favour such a negotiated construction of reality shared for all members of the group. From this perspective, when interacting with music technologies and media, one moves away from being a mere consumer of technology and becomes an agent for the generation of social and individual meaning, as well as the creation of new cultural artefacts (Savage 2012). This reinforces the critical vision in the use of technology and assumes other possibilities of constructing knowledge, generally in a collaborative way (Liu-Rosenbaum and Creech 2021).

Learning processes and outcomes, from this view, are progressive, but not linear. Learners, whether in formal music education or community music contexts, develop their musical understanding through participation in musical ideas and actions with increasing depth and breadth. To some extent, this leads to question how the creativity is approached in music education at schools.

1.3. Creativity in music education

Music creativity processes in primary and secondary educational contexts have been extensively researched (Lewis 2012; Glover 2000). The use of digital technologies has helped to generate new visions and strategies that facilitate composing music in classrooms (Himonides and Purves 2010; Randles 2012; Ruthman et al. 2015; King 2018) and suggestive sound-based approaches (Holland 2015, 2021; Landy 2019). Despite the this, there is still resistance that prevents progress on the negative and positive effects they can bring to students' musical learning. In this sense, some authors criticise a lack of relationship between classroom practices and practices that emerge from informal contexts (O'Neill 2016; Kastner 2020), or the lack of teacher training (Cain and Walden 2019). In relation to the approach to creation in music classrooms, it should be said that the approaches that music teachers in primary and secondary education have been taking have generally been an analytical exercise that has focused more on the object (work) than on the creative processes that involve the students (Regelski 2017).

These trends have conditioned creative work in the classroom. One of them considers composition as an activity of little value compared to the main task of the musician, that is, the performance of music. The other tendency paradoxically conceives composition as a practice reserved for a small talented elite that others can hardly reach. This lack of knowledge, experience and confidence greatly complicates the creative work in music classrooms. In this critical vein, it is argued that the traditional model of music teaching in schools currently has many problems in that it does not consider the musical interests and abilities of the students (O'Neill 2016). Many of the strategies employed are teacher-centred and favour a type of reproductive learning that relegates students to a passive position in the musical learning process through a curriculum that is markedly historical and unmusical (Drummond 2010; Schippers 2010). A formalist-aestheticist paradigm has been privileged over a praxialist-enactivist paradigm (Tejada 2004). An education that focuses on the activity of students as managers of their learning may have the potential to encourage greater motivation and self-regulation of learning through music-making.

In Spain, initiatives around sound-based music-making (SBM) (Murillo et al. 2021) in school settings have been rather scarce. In contrast to countries such as England where pedagogues and researchers such as Dennis (1970), Paynter and Aston (1970) and Savage and Challis (2002) helped to create a rich context linked to musical composition and the development of creativity in school environments. This context, and the need to provide solutions for access to experimental and electroacoustic music, inspired initiatives such as EARS2 (ElectroAcoustic Resource Site 2), a pedagogical environment that has enabled children aged 11–14 to become familiar with the concepts and practice of electroacoustic music (Landy, Hall and Uwins 2013). The Compose with Sounds software (Pearse et al. 2018) was developed specifically for this initiative and has provided a robust framework for intervention in electroacoustic creation processes in school settings. Compose with Sounds is an intuitive DAW for sound-based music creation and recording (Landy 2007). The software has 'sound cards' that contain both oscillators and effects processors. Students use these cards as if they were sound objects, arranging them along the timeline of the program's multitrack interface.

Because of its similarity to the objectives of Soundscapes, the innovative educational project Sonic Postcards (Sonic Arts Network 2007) is worth mentioning. The aim is for students to gain knowledge of their environment and the environment of others, develop musical skills through technology, as well as personal communication skills with others. A sound postcard is a digital audio file. Students must make a

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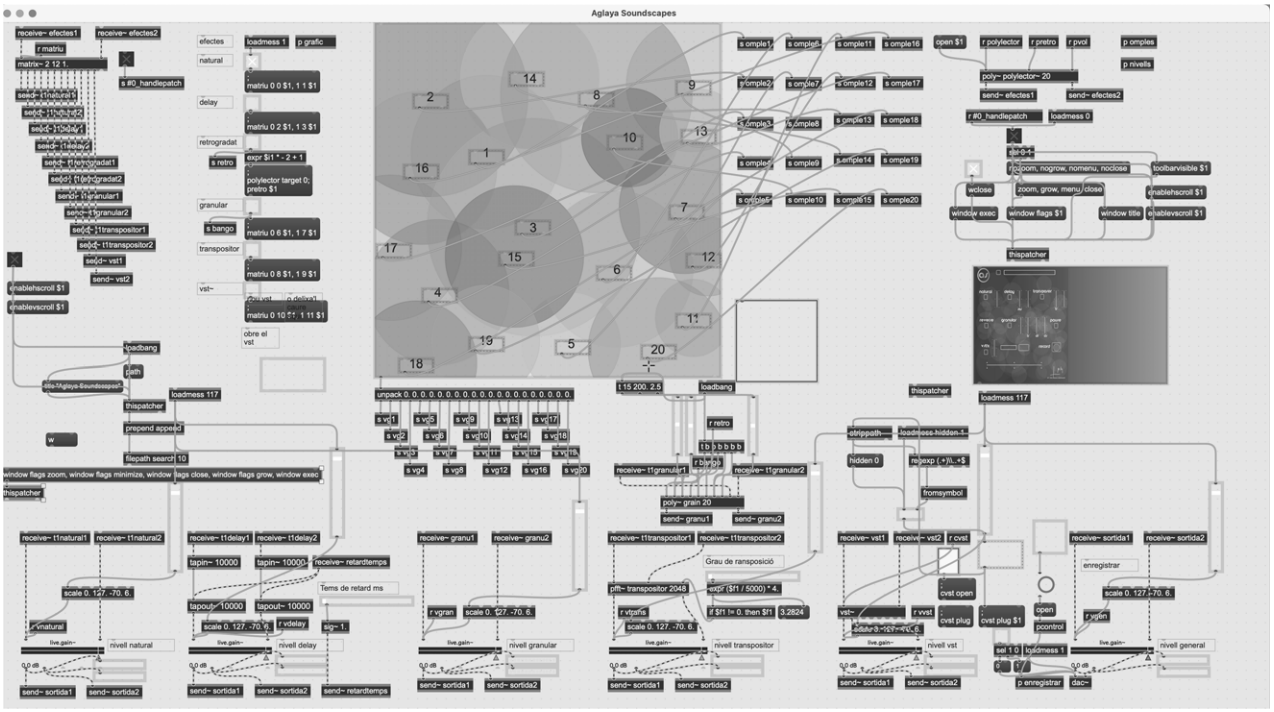

Figure 1. Programming decisions of the Acouscapes software in the MAX programming language.

sound postcard that represents the sound environment. The postcards are made using general software and allow students' sound environments to be listened to and compared and are shared via the internet. The educational focus with these sound documents is on listening and the creative use of technology. Like an ordinary postcard, it offers the opportunity to exchange information about each student's sound habitat, expanding knowledge of a variety of places, lives and cultures, from urban to rural.

Acouscapes was developed as a response to a twofold question within an educational context: is it possible to make students aware of the soundscape that surrounds them through collaborative composition activities of soundscapes using software in the middle and upper cycles (8–12 years) of primary education in Spain? In this line of intentional contact and experimentation with the sonic environment in educational contexts, a project was carried out in a primary school in the city of Valencia, Spain called *Entorno e Identidad Sonora* (Environment and Sound Identity). With it, the teaching team tried to raise awareness and sensitise students to the sound transformations affecting the neighbourhood where the school was located. They also composed soundscape music using sounds recorded and processed by students. To do this, sound walks were carried out to collect sounds from different areas and collaboratively build a soundscape of the neighbourhood in small groups. This allowed the students to contrast the soundscape obtained with the neighbourhood's old soundscape by means of videoconferences and direct interviews with relatives and neighbours aged +65 years. The students were then able to verify the sound transformations that had taken place in the neighbourhood over a period of 50 years. In addition, using the current soundscape of the neighbourhood, each group of students was able to modify the captured sounds and edit the final mix using a series of dynamic, frequency and texture manipulators, forming a composition that was then transferred to an audio file.

2. DESCRIPTION OF THE SOFTWARE

The reader should consider the definition of soundscape as the perception of a sound environment (Sayer, Manvell, Takai and Bazzucchi 2014) from a specific listening point and for a specific set of listeners (Berenguer 2021) in order to understand the technical description of Acouscapes. It is characterised by a unique mixture of sound sources whose intensities are determined, among other variables, by the listening point. This multiplicity of sound perspectives depending on the situation of the listeners is precisely what inspires the programming decisions of Acouscapes (Figure 1). The engine that implements the functions of this software is entirely programmed in the *Max* language (Cycling'74 and IRCAM 2020).

The right half of the Figure 2 shows the graphical element that allows the choice of the user's various perspectives in a sound environment composed of a multiplicity of sources. The nature of this environment

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Controls

1. Main switch : closes the application.
2. Editable text space : the editable name of the current project.
3. Natural Switch : Plays or stops non-processed sounds
4. Natural Slider : controls the level of the non-processed sounds in the general mix.
5. Delay Switch : Play or stops delayed sounds.
6. Delay Slider 1 : controls the delay with respect to the original sound (0 - 5000 ms).
7. Delay Slider 2 : controls level of the delayed sound in the general mix.
8. Transposer Switch : activates-deactivates the transposition.
9. Transposer Slider : controls the transposition (1 = no transposition. Maximum upper transposition 4 = 4 octaves.
Minimum lower transposition 0 = -infinite octaves).
10. Controls the level of the transposer sound.
11. Reverse Switch : retrogrades the audio files.
12. Granular Switch : activates-deactivates the granulation of the audio files.
13. Granular Slider: controls the level of the granular sound in the overall mix.
14. Granular Slider tr: grains transposition controls (pitch change).
15. Granular Slider dr : grains duration controls (milliseconds).
16. Granular Slider ds : grains density controls (grains amount).
17. Pause - Switch : pauses the playback of audio files.
18. VSTFX Switch : activates the current VSTfx plug-in.
19. VSTFX Slider : controls the sound produced by the VSTfx plug-in in the overall mix.
20. VSTFX Button : shows the send to VSTfx
21. VSTFX Drop file : shows the current plugin file.
22. Record Button : Records the resulting mix.
23. Overall Level Slider : shows the mix overall level.
24. Built-in Output: shows the current audio driver.
25. Saves template.
26. Loads template.
27. Drop Soundscape Sound: here, the audio files can be dropped.

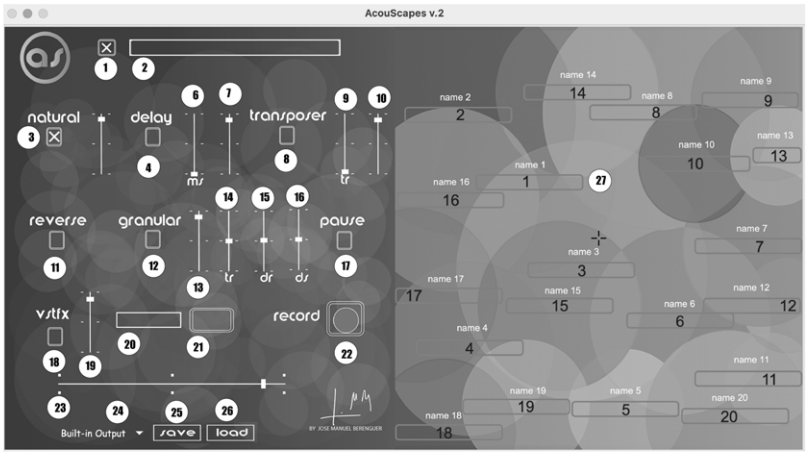

Figure 2. Main interface for Acouscape.

is configurable by means of a single gesture consisting of dragging and dropping the audio file of each source chosen on each of the 20 coloured circles that make up this element. Once the sound sources have been loaded, the user can place the cursor where he/she wants and will obtain a sound mix composed of the sounds that are part of the intersections of the screen circles.

3. SOME EDUCATIONAL APPLICATIONS OF ACOUSCAPES

As mentioned in the introduction, Acouscapes is a software intended to help the achievement of two objectives: to reinforce the awareness of the surrounding soundscape and simultaneously to help in the organisation of sound creations from that soundscape by Spanish middle and upper primary (8–12 years) and secondary (12-16 years) students.

To provide the software with an adequate balance between technological functions and the expected educational objectives, the researchers reviewed the creativity-related objectives specified on the music curriculum under the Spanish national law for primary education, as determined at the Valencian Community (DOGV 2022). This law mentions two objectives related to creative processes. The first is defined in terms of competences and declares that students can use 'different artistic representations and expressions and initiate themselves in the construction of visual and audiovisual products, developing aesthetic sensibility and promoting artistic creation' (ibid.: 41170–1). The second one mentions that 'In each project, students should follow a process that includes research, creativity, decision-making, the use of strategies and communication in different formats. It is necessary to encourage the integration of learning in a cross-sectional, meaningful, and relevant way, and foster collaborative problem solving, to reinforce students' self-esteem, autonomy, reflection, and responsibility' (ibid.: 41172).

Acouscapes was designed and implemented with these objectives in mind, although its real-context empirical validation is still in progress. In the following subsections, some learning activities using Acouscapes are suggested.

3.1. Sound walking

Is it possible to travel through sound? Sound has the capacity to favour access to the deepest memories of our childhood, but it also has the capacity to remind us of the changes and transformations that our contexts undergo due to human action. Thus, it is possible to speak of soundscape as a macro discourse that gives a greater insight into the ways of life of a community (Woodside 2008).

This activity aims to deepen our own landscapes, thus enhancing the environments or sound contexts that make up our personal space. Along these lines, it would be interesting for each student to propose a particular soundscape that defines his or her personal experience, based on his or her environment. In the case that the students are from another country, it would be interesting to look for typical sounds of their environment and to make a sonorous reconstruction of their landscape to share it in the classroom. For this purpose, sounds could be searched for in different online repositories.

By being able to use sounds from different sound contexts linked to the students' origins, it is possible to

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generate descriptive narratives linked to their personal experiences that allow them to share cultural elements with all the students. In this way, feelings of community can be reinforced, favouring more inclusive environments. Sound walking itself would be another task linked to this proposal. This would be a collective experience of exploration and reflection on our surroundings. Sharing a walk with our students and provoking deeper and more attentive listening is a healthy exercise that undoubtedly helps to raise awareness among students and, thus, to improve our sound environments.

3.2. Imaginary landscape

The imaginative capacity allows us to invent everything from new territories to places that move between the real and the unreal: there is no limit. Thus, this activity explores the possibilities of transformation offered by the Acouscapes tool and in this way connects the creative potential of users through exploration and sound experimentation. For this purpose, the left side of the control panel where the manipulation controls are located will be used.

This simple activity can be used to collect ideas for a new project or simply to show the creative potential and imagination of the students. Also, this type of proposal unites music with other areas of knowledge in an interdisciplinary way. In this case the linguistic areas.

For this activity, we propose working with creative compositions drawn from a soundscape selected by the student, later applying the effects controls to the piece until an imaginary soundscape emerges. Upon applying the effects and transforming the soundscape, the initial reference points of the individual sounds are lost, and, therefore, new meanings can be assigned to them. Listening back to the imaginary sound proposals created by the student can contribute to the creation of fantastical stories that can later be share as podcasts.

3.3. Camouflaged sound

Sound designers play with the possibilities offered by the hidden sonorities of objects until they find sounds that are interesting to them. These sounds are then manipulated through digital techniques to use them in film or advertising. By breaking the relationship between the sound and the object that produces it, the mind loses the reference, and a new meaning is generated. In this sense, Chion (2016) mentions 'acousmatic sound' as a term for a sound whose source of origin is unknown.

For the activity of camouflaged sound, we start from the selection of some interesting sound objects and explore their possibilities. We look for different ways to make them sound, combining short and long sounds, to find curious and inspiring results. For this sound exploration to be successful, it is important to look for an unusual sound production mode. For this purpose, different modes of excitation can be used: for example, rubbing, tapping, or clacking the selected object. Thus, you can combine ways of making it produce sound by using different materials, and even try to modify its sound properties; for example, by immersing it in water. There are no limits, only the certainty of not hurting yourself. In this way, the catalogue of sounds that can be found will be much larger.

Then, and after being recorded, these sounds can be subjected to a transformation process using the controls on the left side of the Acouscapes panel, looking for interesting combinations. Once the sound is found, the result is recorded and shared. Of course, the teacher should ask other members of the class to which original sound this new sound belongs.

3.4. Sound cartography

Sound cartography is a resource that allows us to think about the way sounds interact with habitable spaces and map this relationship based on the interpretations of individual listeners. As such, the teaching objective is not merely to quantify sounds, but also to allow students to experience the presence and extension of sound in material things, and to understand these sounds' architectural importance in the neighbourhoods they live in. As part of a class trip, students were able to collect sounds from different places with a digital recorder. They also used sound meters to measure sound pollution and mapped this out using the SonicMaps app.[2] This helped to generate significant reflection regarding the way spaces are transformed by sound. The activity was conducted using several apps[3] and websites[4] that were used as references and amplifiers for the students' work.

3.5. Sound postcards

Finally, we propose making a sound postcard. A first idea is to choose a favourite soundscape and take a photo. This can be a domestic, urban, natural, industrial space. Once the type of landscape you want to use is decided, 20 characteristic sounds of that environment are recorded and uploaded to Acouscapes. It is interesting to make different sound paths. When you have one that you particularly like, you record it. You can also play with imaginary landscapes manipulating those same sounds with Acouscapes' effects. When you have the sound results, you can upload that sound creation to an online

[2]https://sonicmaps.xyz app.

[3]For example, https://drivenlisten.com/#.

[4]These included www.next.cc/journey/discovery/sound-mapping#activity-1 and https://citiesandmemory.com/2015/07/top-sound-maps/.

https://doi.org/10.1017/S1355771823000201 Published online by Cambridge University Press

platform for sharing music (e.g., Soundcloud). Once uploaded, copy the URL and search for a free page to generate a QR code of the recording. Then, the design of the postcard is started. The photo or photomontage is placed on the front, and on the back, space is left to write about the sound experience, along with space for the image of the postage stamp and the QR code. Once the postcard has been made, it could be shared with someone and they can be invited to share their own proposal as well.

4. CONCLUSIONS

Acouscapes has been designed to be used in the process of creation and experimentation of soundscapes. It has a simple interface that facilitates the user an immediate experience with sound. In terms of educational theory, it has been conceived as an open learning tool based on social constructivism (Vygotsky 1978). In other words, as an artefact that mediates the construction of meanings between people, meanings that are the product of social interaction (Blumer 1986).

Working with soundscapes in educational contexts provides an enormous potential for the development of creativity and is the reason for its incorporation in the classroom. Sound has an enormous capacity to evoke past experiences that are part of our connection to a place, a community and its culture. Beyond a concept where it is reduced to natural environments, the soundscape is multidisciplinary in that it brings together disciplines and compositional styles that take references in a wide variety of sound contexts. People are surrounded by sounds, and we create music shaped by our experience of the world. Sound is mediated physically, socially and culturally. It is a way of knowing the world: through sound, we experience accumulations and turn them into phenomena, appropriating them and interpreting them in context through the attribution of meanings that are constantly negotiated with others.

Acouscapes fills a gap in music classrooms in terms of specific digital tools for the didactic approach to soundscapes. Its design could facilitate creative work by enhancing new sound-based approaches (Landy 2007; Holland 2015) that start from and reinforce the imaginative action of the students.

Within some of the possible activities that can be carried out with Acouscapes, it is interesting to address the exploration and collection of sounds from the environment and personal spaces. This would allow a deeper understanding and knowledge of the diversity of ecosystems and would enhance better listening. In relation to the recording, editing and experimentation processes, the software will allow users to know particularities of sound and its available options by exploring manipulative possibilities through the control panel. This type of activities allows the generation of imaginary soundscapes. Other curricular areas such as art or literature could facilitate the integration of these landscapes in the creation of new products linked to sound stories, such as podcasts about sound experiences. Likewise, immersion in composition processes can bring new student-centred strategies and reinforce the creation of authentic learning communities based on a type of collaborative, situated and peer-to- peer learning.

Finally, it is important to highlight that acoustic awareness through soundscapes would be aligned with the sustainable development goals of the 2030 agenda: life of terrestrial ecosystems, climate action, sustainable cities and communities, and health and well-being (United Nations 2015a, 2015b).

Thus, all these elements can bring multidisciplinary value to education in general in addition to reinforcing the importance of artistic areas as tools for transformation and social reflection through a creative approach to soundscapes.

Acknowledgements

This study is part of the project 'Design, construction and validation of a new experimental musical instrument for the 20th century: Towards participatory and creative citizenship practices' (GV/ 2021/136) funded by Conselleria de Innovación, Universidades, Ciencia y Sociedad Digital, Generalitat Valenciana, Spain.

REFERENCES

Berenguer, J. M. 2021. Del entorno sonoro y la instalación [Of the sound environment and the installation]. *Laocoonte. Revista de Estética y Teoría de las Artes* **8**: 131–2. https://doi.org/10.7203/Laocoonte.0.8.21256.

Blumer, H. 1986. *Symbolic Interactionism. Perspective and Method*. Berkeley, CA: University of California Press.

Bower, M. 2019. Technology-mediated learning theory. *British Journal of Educational Technology* **50**(3): 1035–48. https://doi.org/10.1111/bjet.12771.

Cain, M. and Walden, J. 2019. Musical diversity in the classroom: Ingenuity and integrity in sound exploration. *British Journal of Music Education* **36**(1): 5–19. https://doi.org/10.1017/S0265051718000116.

Chion, M. 2016. *Sound: An Acoulogical Treatise*. Durham, NC: Duke University Press.

Cycling'74 and IRCAM. 2020. Max-MSP (computer software).

Denis, B. 1970. *Experimental in Schools: Towards a New World of Sound*. New York: Oxford University Press.

DOGV. 2022. DECRETO 106/2022, de 5 de agosto, del Consell, de ordenación y currículo de la etapa de Educación Primaria [Regional Law106/2022 for the Organisation and Curriculum of the Primary Education Stage]. https://dogv.gva.es/datos/2022/08/10/pdf/2022_7572.pdf (accessed 6 February 2023).

Drummond, J. 2010. Re-thinking Western Art Music: A perspective shift for music educators. *International*

Journal of Music Education **28**: 117–26. https://doi.org/10.1177/0255761410362854

Elliott, D. J. and Silverman, M. 2015. *Music Matters*, 2nd edn. New York: Oxford University Press.

Farina, A. 2014. Soundscape and Landscape Ecology. In A. Farina (ed.) *Soundscape Ecology*. Berlin: Springer, 1–28. https://doi.org/10.1007/978-94-007-7374-5_1.

Glover, J. 2000. *Children Composing 4-14*. Abingdon: Routledge

Himonides, E. and Purves, R. 2010. The role of technology. In S. Hallam and A. Creech (eds.), *Music Education in the 21st Century in the United Kingdom: Achievements, Analysis and Aspirations*. London: Institute of Education, 123–40.

Holland, D. 2015. A Constructivist Approach for Opening Minds to Sound-Based Music. *Journal of Music, Technology and Education* **8**(1): 23–39. https://doi.org/10.1386/jmte.8.1.23_1.

Holland, D. 2021. Reaching Out and Beyond: Creating a Legacy for Sound-Based Creativity in Primary Schools. *Proceedings of the Electroacoustic Music Studies Network Conference*, De Montfort University, Leicester, November 2021. https://zenodo.org/record/5806574#.Yqngai8w1mM (accessed 6 March 2023).

ISO 12913-1. 2014. Acoustics — Soundscape — Part 1: Definition and Conceptual Framework. *International Organization for Standardization*. www.iso.org/obp/ui/#iso:std:iso:12913:-1:ed-1:v1:en (accessed 6 February 2023).

Kastner, J. D. 2020. Healing Bruises: Identity Tensions in a Beginning Teacher's Use of Formal and Informal Music Learning. *Research Studies in Music Education* **42**: 3–18. https://doi.org/10.1177/1321103X18774374.

King, A. 2018. The Student Prince: Music-Making with Technology. In G. McPherson and G. Welch (eds.), *Creativities, Technologies and Media in Music Learning and Teaching: an Oxford Handbook of Music Education (Vol. 5)*. New York: Oxford University Press, 162–78.

Labelle, B. 2010. *Acoustic Territories. Sound Culture and Everyday Life*. London: Continuum International Publishing Group.

Landy, L. 2007. *Understanding the Art of Sound Organization*. Cambridge, MA: MIT Press.

Landy, L. 2019. Re-composing Sounds … and Other Things. *Organised Sound* **24**(2): 130–8. https://doi.org/10.1017/S1355771819000177.

Landy, L., Hall, R. and Uwins, M. 2013. Widening Participation in Electroacoustic Music: The EARS 2 Pedagogical Initiatives. *Organised Sound* **18**(2): 108–23. https://doi.org/10.1017/S1355771813000034.

Lewis, R. 2012. Composing the Curriculum: Teacher Identity. *British Journal of Music Education* **29**(2): 153–61. https://doi.org/10.1017/S0265051712000198.

Liu-Rosenbaum, A. and Creech, A. 2021. The Role of Technology Collaborative Learning in Mediating on Music. In A. Creech, D. Hodges and S. Hallam (eds.) *Routledge International Handbook of Music Psychology in Education and the Community*. Abingdon: Routledge, 433–48.

Martin, B. 2017. Soundscape Composition: Enhancing Our Understanding of Changing Soundscapes. *Organised Sound* **23**(1): 20–8. https://doi.org/10.1017/S1355771817000243.

Murillo, A., Riaño, M. A. and Tejada, J. 2021. Aglaya Play: Designing a Software Solution for Group Compositions in the Music Classroom. *Journal of Music, Technology & Education* **13**(2–3): 239–61. https://doi.org/10.1386/jmte_00025_1.

O'Neill, S. A. 2016. Transformative Music Engagement and Musical Flourishing. In G. E. McPherson (ed.) *The Child as Musician*, 2nd edn. New York: Oxford University Press.

Paynter, J. and Aston, P. 1970. *Sound and Silence. Classroom Projects in Creative Music*. New York: Cambridge University Press.

Pearse, S., Landy, L., Chapman, D., Holland, D. and Eniu, M. 2018. Composing with Sounds: Designing an Object-Oriented DAW for the Teaching of Sound-Based Composition. https://core.ac.uk/download/pdf/228190591.pdf (accessed 6 February 2023).

Pijanowski, B. C., Farina, A., Gage, S. H., Dumyahn, S. L. and Krause, B. L. 2011. What is Soundscape Ecology? An Introduction and Overview of an Emerging New Science. *Landscape Ecology* **26**: 1213–32. https://doi.org/10.1007/s10980-011-9600-8.

Randles, C. 2012. Music Teacher as Writer and Producer. *The Journal of Aesthetic Education* **46**(3), 36–52. https://www.muse.jhu.edu/article/484781 (accessed 7 February 2023).

Regelski, T, A. 2017. Pragmatism, Praxis, and Naturalism: The Importance for Music Education on Intentionality and Consummatory Experience in Musical Praxes. *Action, Criticism, and Theory for Music Education* **16**(2): 102–43. https://doi.org/10.22176/act16.2.102.

Ruthman, S. A., Tobias, E. S., Randles, C. and Thibeault, M. 2015. Is It the Technology? Challenging Technology Determinism in Music Education. In C. Randles (ed.) *Music Education: Navigating the Future*. Abingdon: Routledge, 122–38.

Savage, J. 2012. Driving Forward Technology's Imprint on Music Education. In G. McPherson and G. Welch (eds.) *The Oxford Handbook of Music Education, Vol. 2*. Oxford: Oxford University Press, 492–511.

Savage, J. and Challis, M. 2002. A Digital Arts Curriculum? Practical Ways Forward. *Music Education Research* **4**(1): 7–23. https://doi.org/10.1080/14613800220119741.

Sayer, A., Manvell, D., Takai, T. and Bazzucchi, V. 2014. ISO 12913-1:2014. Acoustics – Soundscape – Part 1: Definition and Conceptual Framework. *International Organization for Standardization*. www.iso.org/standard/52161.html (accessed 7 February 2023).

Schafer, R. M. 1969. *The New Soundscape: A Handbook for the Modern Music Teacher*. Mississauga, ON, Canada: Berandol Music.

Schafer, R. M. 1977. *The Soundscape. Our Sonic Environment and the Tuning of the World*. Vochester, VT: Destiny Books.

Schippers, H. 2010. *Facing the Music: Shaping Music Education from a Global Perspective*. New York: Oxford University Press.

Sonic Arts Network 2007. *Sonic Postcards*. soundscotland.co.uk/participate/schools/resources/sonic-postcards (accessed 27 January 2022).

Southworth, M. 1967. The Sonic Environment of Cities. Master thesis, Massachusetts Institute of Technology.

Tejada, J. 2004. Música y mediación de la tecnología en sus procesos de aprendizaje [Mediation of technology in the music learning processes]. *Educación XX1* **7**(1): 15–26. https://doi.org/10.5944/educxx1.0.7.327.

Truax, B. 2002. Genres and Techniques of Soundscape Composition as Developed at Simon Fraser University. *Organised Sound* **7**: 5–14. https://doi.org/10.1017/S1355771802001024.

United Nations. 2015a. Sustainable Development Knowledge Platform. https://sustainabledevelopment.un.org/ (accessed 9 February 2022).

United Nations. 2015b. Transforming Our World: The 2030 Agenda for Sustainable Development, A/RES/70/. *United Nations*. https://bit.ly/3QbxIRF (accessed 9 February 2023).

Vygotsky, L. S. 1978. *Mind in Society*. Cambridge, MA: Harvard University Press.

Westerkamp, H. 2002. Linking Soundscape Composition and Acoustic Ecology. *Organised Sound* **7**(1): 51–6. https://doi.org/10.1017/S1355771802001085.

Woodside, J. 2008. La historicidad del paisaje sonoro y la música popular [The historicity of soundscape and folk music]. *Trans. Revista Transcultural de Música* **12**(2): 1–17. www.sibetrans.com/trans/articulo/106/la-historicidad-del-paisaje-sonoro-y-la-musica-popular (accessed 12 June 2022).

Wrightson, K. (2000). An Introduction to Acoustic Ecology. *Soundscape: The Journal of Acoustic Ecology* **1**: 10–13. www.econtact.ca/5_3/wrightson_acousticecology.html (accessed 11 February 2023).