SOUNDCOOL: NEW TECHNOLOGIES FOR MUSIC EDUCATION*

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Abstract

This paper proposes a new model for music education based on the use of the application *Soundcool*, a modular system for music education with smartphones, tablets and Kinect developed by Universitat Politècnica de València (UPV) through UPV (2013, Spain) and Generalitat Valenciana (2015-2016, Spain) projects. *Soundcool* has been programmed in Max, a modular graphical programming environment for music and interactive multimedia creation, and uses Open Sound Control, designed to share information in real time over a network with several media devices. Our application is a creative development environment in its own right, but for running Max patches it requires only the free application Max Runtime/Max player. The pedagogical architecture of *Soundcool* is based on three music education scenarios that allow interaction between the various agents involved in the classroom. Soundcool is going to be used as a music education tool in several European countries through an Erasmus+ European project.

Keywords: Soundcool, Music Education, Innovation Technology, Interfaces, OSC, MAX.

1 INTRODUCTION

New schemes for human-computer interaction (HCI), such as the low-cost interface Kinect [1], tablets and smartphones are promising tools to improve the motivation and interest of students, to develop their cognitive skills and to support the learning process. However, music education in many elementary or secondary level classes generally revolves around classical music and is oriented towards traditional musical language and the conventional use of instruments such as flute, piano, etc. The incorporation of new audiovisual technologies and interfaces in music production, where practically any sound material can be used, suggests that we incorporate these technologies into music instruction in order to motivate students and improve the learning process. Thus, the first objective of our project *New Audiovisual Technologies and Interfaces for Music Education and Sound Creation* [2], started in January 2013 with an Universitat Politècnica de Valencia (Spain) grant and, in 2015-2016, with the Generalitat de Valencia (Spain) grant AICO/2015/120, was to implement a modular software system based on low-cost interfaces such as tablets, smartphones and Kinect for music education and sound creation, named *Soundcool*. We also plan to build a collaborative web creation system. *Soundcool* has been adopted in the Erasmus+ project 2015-1-ES01-KA201-016139, to be used in Italy, Portugal, Romania and Spain for music education through collaborative music creation. At a time of high budget cuts in education, the implementation of a low cost education system that might spread into different educational institutions is an important contribution of the university to society. To avoid extra costs, the application is intended to use the typical resources that may be available in any classroom and those that students can easily have themselves (tablets, smartphones, etc.). The implementation platform is Max/MSP/Jitter [3]. Max is a modular graphical development environment for music and multimedia creation developed by Cycling '74 which allows the processing of audio and video in real time. Due to its extensible design and graphical interface, it is widely used by composers, artists and software developers interested in creating interactive programs. Our application is a creative development environment in its own right, but for running Max patches it requires the application Max in the free player version (Max Runtime in Max 6 or Max without authorization code in Max 7). For communication between devices and sensors, we use the OpenSound Control (OSC) protocol [4] from UC Berkeley CNMAT (Center for New Music and Audio Technology). OSC is designed to share information in real time over a network, enabling the communication between electronic musical instruments, computers and other media devices, such as mobile devices equipped with Wi-Fi or Bluetooth. This protocol, along with applications such as

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TouchOSC [5], allows the creation of tactile interfaces in tablets and smartphones, as well as using Kinect to control applications developed in Max.

2 NEW TECHNOLOGIES FOR MUSIC EDUCATION BASED ON CREATION

In the Spanish educational system, musical practices aimed at the development of creativity through creation are scarce. In fact, current practice is more focused on formalist approaches that emphasize theoretical content over the practice of music making. There is another important factor to be taken into account when analyzing this situation. In general, music teachers received their musical training in classical conservatories, and they usually offer some resistance to practical implementation. Technology is not perceived as a tool that helps to break down the practices that prioritize western music from the infinity of currents that are merged into the conglomerate of cultures that coexist in society [6]. Our contribution is focused on the transformation of these practices by designing a tool that integrates ancient and modern approaches. In the instructional design of *Soundcool*, various training scenarios were developed that allow classroom collective work in small groups [2]. These scenarios encourage peer learning and foster the autonomy of our students through the control of the system, creating spaces and environments that improve creativity. The last of the scenarios consists of a performance where all that the students have learned in the previous scenarios can be applied to a concert spectacle where music, sound, images, dancing, etc. will be produced. The concert can use acoustic and electronic instruments along with additional sounds and processing by *Soundcool*, controlled by devices like tablets or smartphones. The designs of the different scenarios and the use of the *Soundcool* system allowed us to develop different projects, see [7], which are presented in this paper.

3 TECHNOLOGICAL ARCHITECTURE: THE SOUNDCOOL SYSTEM

3.1 Soundcool application

Soundcool is a growing modular system which deals with the basic concepts of audio processing. *Soundcool* modules include (Fig. 1): *record* (from any input device or from another module); *play* (at an indicated speed with optional looping); *feedback delay*, *panoramic*, *transposer* and *pitch shift*; *audio routing*; *mixer*, with 8 inputs; *VST host* to incorporate VST instruments and effects; *keyboard*, to receive MIDI notes and controls from a smartphone/tablet via TouchOSC; *spectroscope* and *oscilloscope* to visualize audio signals in the frequency and time domains; *sample player* to load and play up to 12 audio samples in one module; *direct input* module to capture microphone or line-level input; *filter*, with 10 different filter modes; *signal generator*, to create different kinds of waves based on Frequency Modulation, Amplitude Modulation or Ring modulation; *sequencer,* to automate sounds from the *signal generator* module; *envelope*; and *audio Module* to configure audio in/out and MIDI devices.

Most of these can be controlled by iOS or Android tablets/smartphones, and Kinect, with very simple and homogeneous interfaces (Fig 2). The teacher or students should setup the desired combination of modules and their connections in the computer or computers available in the classroom for each concrete activity. Then, each student can control one of the modules with his/her own smartphone/tablet or Kinect being placed in whichever place around the class the activity needs. All the modules are executed with Max Runtime/Max player. In general terms, modules have inputs and outputs, and outputs are connected to inputs similarly to the way it is done in Max. The main difference is that in Max the connections are done with “cables”, but when using Max Runtime/Max player that capability is not available due to the restrictions of the free version of Max. Instead of this procedure, the modules are connected “wirelessly” by using Max native objects “send” and “receive” (and their signal versions “send~” and “receive~”). There are input and output buttons in all the modules, and the connections are made by pressing an output button first and then an input button. An output can be connected to several inputs and each input has a disconnect button as well. As for the OSC communication between the computer and other mobile devices, all the devices must be connected to the same network and the sending address of the mobile devices must be set up to the IP address of the computer where the modules are being run. Additionally, the receiving port for each module can be configured to match with the sending port of each mobile device so that each device can control a different module. The different modules are being tested by authors A. Murillo, and E. Carrascosa, pedagogues and music teachers, responsible for pilot tests at several European countries through the Erasmus+ Project 2015-1-ES01-KA201-016139 (Fig. 3).

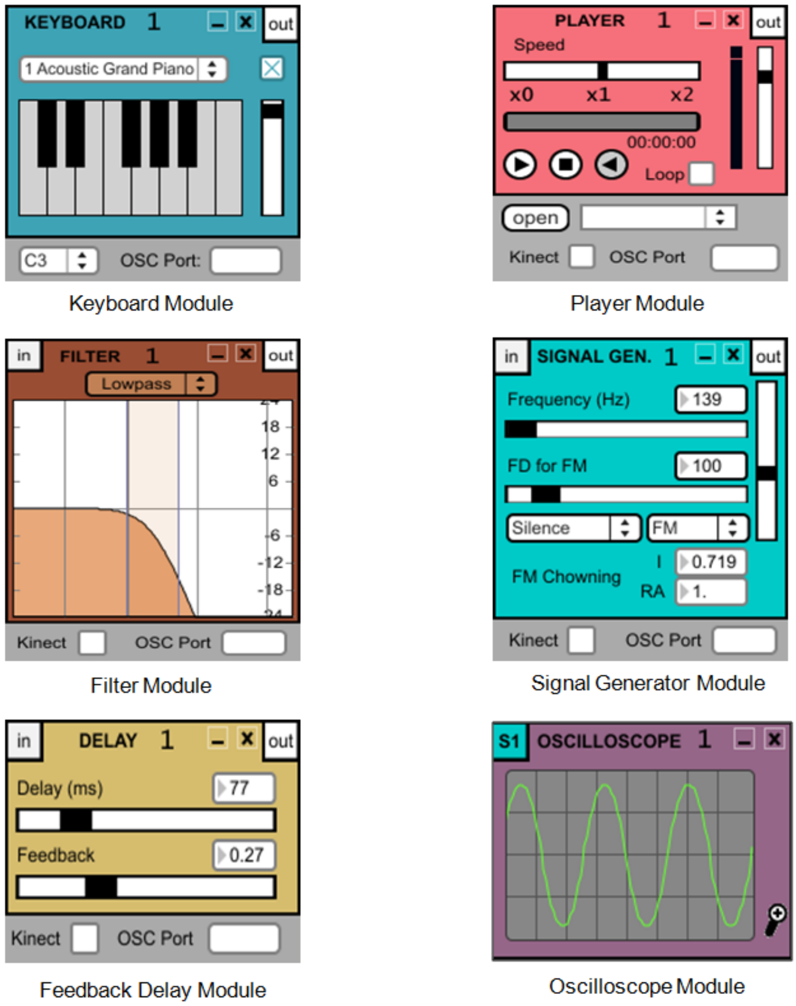

Figure 1: Several Modules

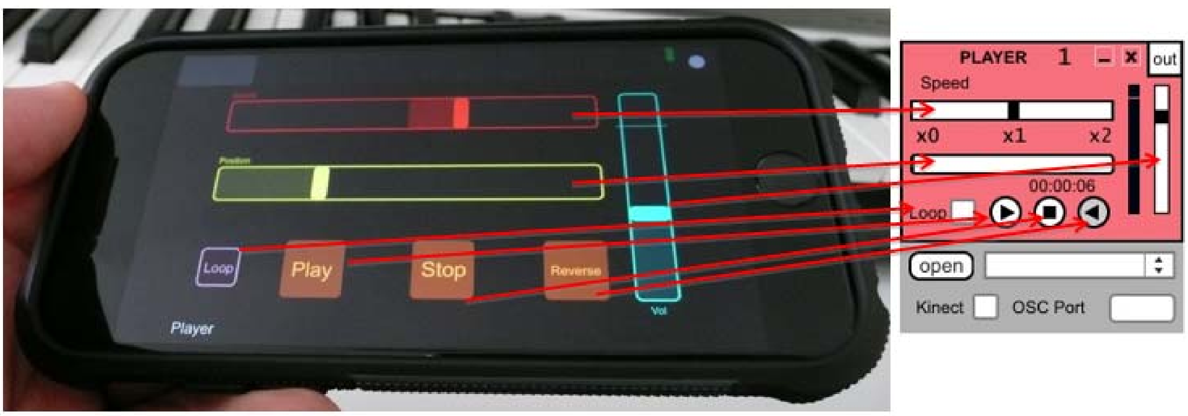

Figure 2: OSC module control for smartphone/tablet

3.2 Soundcool design

The *Soundcool* interface addresses two important issues: the lack of resolution of many data projectors in the classroom and the absence of graphic lines or "patch cords" between the *Soundcool* modules, which are represented as individual windows. Modules are designed to fit in a standard screen of 800 x 600 pixels. Flat colors and simple design help each student to identify the module for which they are responsible during the collaborative performance. In order to avoid the overlapping of the windows, we designed three custom window states: minimized (Fig. 4) and normal (Fig. 1) for simple modules, plus maximized-zoom for complex ones (Fig. 5). This makes the creation and the editing on small screens even easier. To visualize the relationships between modules, we opted for codes of colors and numbers to allow the users to see at a glance which inputs and outputs of each module are connected with each other. This code is located at the corners of the window as an icon of input and output, identifying which module is connected at all times and allowing changes with a single mouse click (Fig. 6). We are planning to include a collaborative creation system based on Web 2.0 and Social Networks. With this system, students from different schools will be able to share their projects and contribute to repositories of sound samples or modules that can be used for the creation of other projects by other students and institutions.

Figure 3: *Soundcool* pilot tests at *IES Arabista Ribera* School (Spain, Images by R. Sanchís)

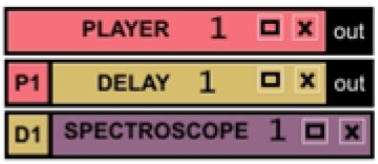

Figure 4: Example of minimized modules

4 PEDAGOGICAL ARCHITECTURE

4.1 Explanation of the design

As mentioned above pedagogical architecture is based on three scenarios (Fig. 7) or teaching situations that allows interaction between the various agents involved in the classroom. Working with these scenarios allows, on one hand to provide a framework for researchers observation, and on the other hand, to place the focus of the research not only in the tool, but also in the interactions that unfold through collaborative creation actions. Working in these three scenarios in the pilot study allowed the researchers to develop both technical features of the tool and didactic aspects.

The first scenario or didactic situation focuses on the teacher-student relationship redrawing a dialogic situation, allowing the educational agents to relate in a more horizontal way. The objective of this scenario is to share, as an open debate, the various working proposals to allow the “chorality” of the voices participating in the process. Normally, students are used to follow a more directed style of

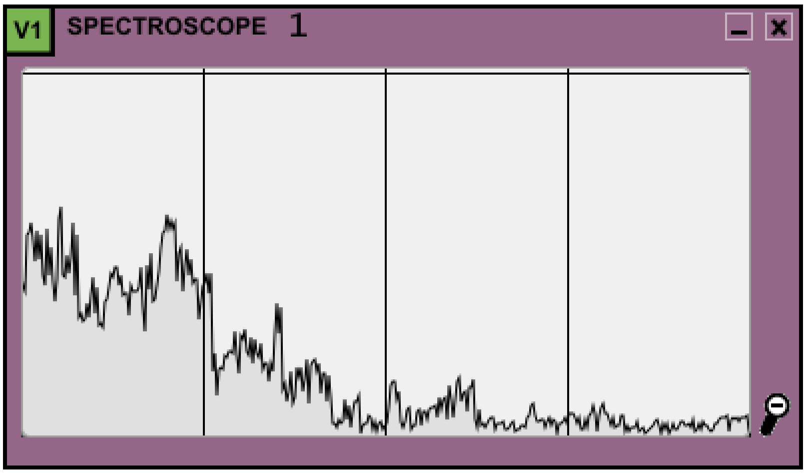

Figure 5: Example of maximized-zoom for complex modules

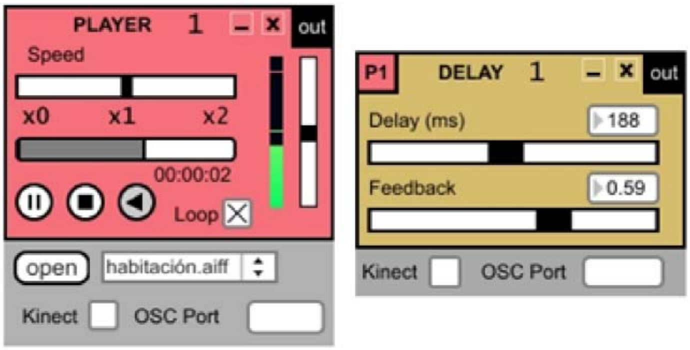

Figure 6: Example of connection between modules

teaching and learning and this educational situation allows them to release their imagination and to share their ideas with the rest of the group. It is clear in this type of processes that are based on the diversity of interactions that provide a higher quality of the generated proposals, as these are based on processes that are collectively filtered to reach consensus and group acceptance.

The second scenario focuses on collaborative group work and it facilitates the interaction of participants in small groups. Observations made in this scenario offer a view of the tensions and approaches that occur during teamwork. Group work causes the arousal of unique opportunities to strengthen collaborative work through individual and group reflection and self-perception. The contributions made individually and the efforts to fit them into the structure of the composition enables peer learning; students learn how to manage information sharing their doubts, findings and solutions with their peers in the benefit of the group work and the musical product.

The proposals generated in this second scenario and which have previously been agreed in the whole-class group (first scenario) let to achieve a new level of personalization and differentiation of ideas based on the general topic on which the group is working. This allows focusing on more specific proposals that work as prototypes or micro creations. Also, the different scenarios offer the opportunity to the researchers to observe how the students display their organizational strategies in the work division between the group components, and how students seek solutions or solve any technical or conceptual problems that arise in the process of creation. It is in this scenario where more sound experimentation is made as the system allows combinations in modules that facilitate unforeseen combinations, sound manipulation and transformation that can be recorded in real time through a recording module. Completely unexpected uses were observed in the combination of the modules of *Soundcool* that went beyond the basic instructions that the teacher previously transmitted to his students at the beginning of the presentation session. In some cases these unexpected uses were the result of reflection and search for new sounds and sometimes the result of errors that were exploited in an eager and intelligent way by the students makes the error a new opportunity.

Figure 7: Scheme of pedagogical scenarios or teaching situations.

Finally, the third scenario is the result of filtering the proposals made by the small groups and facilitate progress from micro to macro creations. Completion of the final musical creation is made from the selection of the different pieces of a puzzle that must be fitted through a selection process involving the general consensus of the large group. The third scenario explores shared listening; it is during this type of group listening that the multiplicity of sound ideas are exposed and shared by the different groups participating in the performance.The end result is a concert or a stage performance. Live performance provides a new framework for observation, the different actions of collaborative construction, adjustments in interpretation and the shared feeling in the same concert bring new ideas that improve the same building or suggest further corrections for subsequent compositions. Likewise, the concert context is an undeniable social interaction space since the performance allows the consolidation of the group, strengthening ties to emotional and social level among students, the teachers and the public participating.

Recently, various researches [8] argue that technological tools shape their teaching purposes but do not determine them; more even, in some cases there is a gap between the intended uses of the tool and what eventually occur in the classroom. Each of the *Soundcool* proposed scenarios allow developing elements, which feed the different actions of creation and help focus classroom work in how technologies are used and not on what technologies are used.

Moreover, [9] note that the new technologies are difficult to implement in the classroom because sometimes their use is not linked to the needs that arise in the classroom.

Given this set of assumptions, the *Soundcool* system was designed with a clear pedagogical objective: to rely on technology to encourage more creative thinking in the classroom. For this purpose we advocate a new paradigm focused on collaborative and creative learning, where the tool is treated just as an extension of that creative thinking. As [10] states, "the technological means are extensions of our bodies, our desires, they open doors to perception and extend our perception" (p.45).

4.2 The music classroom as sound lab

Another aspect to take into account about *Soundcool* is its ability to integrate the musical instruments available in the classroom, such as Orff instruments or recorders with ICT (Information and Communication Technology). *Soundcool* was not designed with the intention to replace or remove the musical instruments that are usually available in the music classrooms, but the objective was to offer students and faculty the ability to transform that same classroom towards a concept of sound laboratory, suggesting the fusion between digital and analog sound, between old and new. In this way, the system can enrich the sound palette available in the classroom without having to discard musical instruments that are part of standard practice in many music classrooms.

Soundcool's ability to integrate facilitates the change towards a real transformation in the concept of classroom that would connect the experiences of the students and their imagination through creative processes that enhance student's learning. In this way students interact with each other, encouraging balance between their practices out of school and those that occur in the classroom.

Likewise, the use of these new technologies allows new classroom disposition. The classroom organization should provide a creative environment and this should enable new flexible and changing groupings among students, corners or areas that help and complement the work of sound experimentation that is indispensable in any process of sound creation. As [11] argue, "the contents remain linked to the abilities to know, to be, to do and to live together; on the other hand, the need for learning not reduced to memorization, but to be in a position to be applied in all circumstances of life" (p. 11). Thus, new digital tools allow students to transit in unexplored land and to go beyond the common or customary sounds and structures [12].

4.3 Teacher training. New practices focused on sound creation

As [9] state, teachers do not have to focus on teaching the use of ICT but they need to serve as guides investigating the way in which students can use technology resources wisely. In a similar way, one of the cornerstones of the educational commitment that has been made through the *Soundcool* system has been teacher training. Different teacher training workshops were made during research and it is an important purpose of the tool to introduce a disruptive model that breaks with the historical model of musical education in order to embrace the proposal for creation. Usually each workshop focuses on a creation proposal. First, the management of the system is explained, and then musical creation is started. It was in this second stage where major problems were detected, so we concluded that teachers needed more training to actually cause changes in the musical practices in the classrooms.

Redirecting musical practices towards more participatory and creative models of teaching and learning involves deploying a range of strategies that should help to redefine a new teacher's role that allows the change towards a less mechanical and more consistent learning with the requirements of the twenty first century society.

5 RESULTS

5.1 Soundcool in the music classrooms

The fieldwork with high school students from the Secondary School *Arabista Ribera* from Carcaixent (Valencia), provides data that encourage us to think that *Soundcool* could be a system with excellent potential to promote creativity and collaborative work in the music classrooms. Its simple design and its learning curve, allows the students to handle the tool in an efficient way in very few lessons.

5.2 Soundcool teacher training

Since the beginning of the project, *Soundcool* generated curiosity in a group of musical education teachers from all educational levels (primary, secondary and university level). The reason was obvious; *Soundcool* is a free off-line tool with a vast palette of instruments and possibilities that is available to all teachers and students to work through mobile devices. Additionally *Soundcool* uncovered the hidden difficulty to work with music creation in the classrooms in a collaborative way. Consequently there was the need of a pedagogical framework to settle this important contribution.

Different workshops to introduce *Soundcool* all over the Spanish territory were conducted by researcher Adolf Murillo; among them there was a seminar about good educational practices organized by the centre of studies of the Federation of Music Societies of Valencia (FSMCV) entitled "Musical creation and improvisation: the mechanics of sound creation" which had the collaboration of the luthier and creator Angel Di Stefano, the improviser and teacher Josep Luis Galiana and the composer Llorenç Barber. Thirty teachers of music schools accompanied by their students attended this seminar; among the participants was the group ExperimentArts (GEA) of the Secondary School Arabista Ribera of Carcaixent (Valencia) where the seminar took place. In this seminar there were two sessions that allowed the participants to engage in various activities of musical creation using both acoustic instruments and electronic sounds in a unique symbiosis.

This seminar was focused on the concept of collaborative work between teachers and students, all in a musical composition in real time. The teachers that participate in this seminar completed a survey that raised the need for initial and continuous development on new creative paradigms according to the reality of the twenty-first century. Participants also expressed the need to put aside their fears to use ICT in the classroom.

6 CONCLUSIONS

The conclusions of this study are that there is a need for deepening in the methodological approach of collaborative music creation using mobile devices, and in this sense, *Soundcool* is a very useful tool usable in all levels of education, both formal and informal. The data from the surveys completed in all of the workshops that were conducted demonstrate the need for professional development courses to implement creative pedagogical approaches using collaborative music creation in the classroom. From the prospective, *Soundcool* will be used in the next two years of the above mentioned Erasmus+ project with primary, secondary and music schools from Spain, Italy, Portugal and Romania. This experience will strengthen the project and generate the educational materials necessary for the spread of *Soundcool* at a large scale. We believe that this tool and the pedagogical framework underneath will make a big contribution to the twenty first century music education.

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