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ARTICLE

'It blew my mind'. Creating spaces for integrating creativity, electroacoustic music and digital competencies for student teachers

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Abstract
This exploratory study describes the design and implementation of a sound-based intervention in the initial training of specialist music teachers at a Spanish university. It aimed to create spaces geared towards more creative and contemporary approaches to musical learning in order to gauge the perceptions of trainee teachers regarding this kind of approach. The intervention (45 h of class time) was based on the creation of electroacoustic compositions following the SBM (Sound Based Music) approach using digital tools (Aglaya Play, AP). Qualitative process data were collected through self-reports, individual memories, and nine focus groups. The results suggest that the implementation of new intervention models that take into account the development of future teachers' creativity with activities focused on exploration, experimentation, and creation with sound can generate new opportunities to enrich their teaching identities.

Keywords: Beliefs and values; musical creativity; initial specialist teacher training; Sound Based Music

Introduction

Information and communication technologies have revolutionised teaching and learning processes. However, it has been shown that merely providing students and teachers with technological resources is not enough to improve their digital skills (European Commission, 2019). In this sense, new pedagogies are needed, built around current technological advances, to foster active participation and collaborative learning (OECD, 2015). An example of the provision of technological resources being insufficient to improve digital skills can be found in the Spanish context. In recent years, Spain has been at the forefront of ICT training in Europe; however, its teachers continue to consider that they have a low level of training in the integration of technological media in the classroom (Calderón-Garrido et al., 2021). This could be due to the fact that the technological training provided was not related to school content, i.e. its application at school and how to teach it to students (Tejada & Thayer, 2019).

In the context of music education, technologies should be considered, besides providing didactic support, as languages and experiences that profoundly shape children's musical learning processes and musicality (Johnston et al., 2015). As suggested by other authors, technologies should be seen as extensions of the body itself (Corradini, 2011; Leman and Nijs, 2017), as forms of experimentation and creative reflection (Cheung, 2016), or spaces where students' musical experiences, interests and needs are connected (Juntunen, 2014). In this framework, the support and stimulation of the teacher as a facilitator of divergent thinking (Brown, 2007; Kladder & Lee, 2019) can be decisive in producing a transformation in the ways students use and perceive technology.

In addition, teamwork and interdisciplinary approaches (Ruthmann & Dillon, 2012), enriched through the multiple modes of representation offered by technology, can be a stimulus for students to explore their individualities (Banaji et al., 2010) and enable them to research, monitor, record, participate and share with their peers for the benefit of their musical and emotional development (Himonides & Purves, 2010). Furthermore, the crossing of disciplinary boundaries and interdisciplinary collaborations are also strongly associated with new teaching approaches (Xenitidou & Gilbert, 2010). Alongside these benefits, it is also important to note that collaborative sound creation stimulates interactive communication and socialisation even if this takes place online (Biasutti & Concina, 2021). This is why technology can be seen as a bridge between 'school' and the professional world of music, as 'the bridge between "school" music and music "lived" by young people' (Gall & Breeze, 2007, p. 42).

Music has been part of Spanish compulsory education since 1990 (Belletich et al., 2016). However, a gap in the use of technology in the training of specialist music teachers in Spain should be mentioned here, as there is still a high number of teachers who have a superficial knowledge of technology, and use it in a limited way in the preparation of their classes, or hardly use it in the classroom (Calderón-Garrido et al., 2020). Another element that hinders the incorporation of this musical educational approach by teachers in compulsory education is the lack of promotion from the national curricula. Thus, there are two major difficulties: on the one hand, these curricula tend to incorporate few recommendations that refer to the use of technologies (Mateu-Luján, 2021) and, on the other hand, some teachers recognise the difficulty of including didactic proposals that foster creativity within the daily routine without committed educational policies (Arostegui, 2016).

Nevertheless, reversing this current situation is a complex task, since new teachers can come to the profession with a very definite educational conception based on their own experience as primary and secondary school students (Randles & Tan, 2019). The needs of 21st-century schools often bear little relation to the informal musical practices of students in their daily lives (O'Neill, 2015). Not surprisingly, these outdated approaches can be continually reinforced in initial teacher education in many universities (Regelski, 2017). These positionings are generally linked to styles where a concept of tonal music prevails (Ross, 1995; Regelski, 1997; Bouij, 2004; Bowman, 2009). While some authors such as Kos (2018) or Gates (2010) point out that Western music teaching can serve as a basis for novice teachers, it may end up generating tensions between teachers and students due to a lack of adaptation to the ever-changing classroom environment.

However, there have been a number of initiatives to address this deficit in teacher education. In this regard, as Randles & Tan (2019) argue, the design of initial teacher education programmes is of vital importance in ensuring identity development. These programmes can strengthen music teachers' identities through the inclusion of composition, improvisation and popular music performance practices.

In this context of digitalisation of teaching, music education in Spain is not very different from other countries and faces similar problems to other curricular areas. Mainly, there are two reasons why the use of technology in music classrooms is not always possible: the lack of computers and other equipment issues, and the lower levels of readiness to teach music in classes (Bauer & Dammers, 2016; Gall, 2013). Thus, music teachers, despite having incorporated technology into their classes, continue with structured, linear and traditionalist teaching that prevails over the creative (Savage, 2010). It is true that the use of technology in music classrooms has succeeded in increasing students' motivation in the teaching and learning process (Wang, 2022). However, its possibilities in relation to the ability to transform sound have been little exploited. Better implementation results could be achieved through school innovation, equipping trainee teachers with new tools that allow them to approach music learning in a more creative and participatory way, both for themselves and for students (Wolf & Younie, 2019). From a more creative approach, digital tools applied to sound have made it possible to bring music closer in ways that were unthinkable only a few years ago and, to some extent, have democratised the creative act

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(Ruthmann et al., 2015). These new ways of creating have made it easier for people with no prior knowledge of music to make and transform their own music (Holland & Chapman, 2019). Thus, creative work with music under the concept of SBM Sound Based Music – electroacoustic music – (Landy, 2007; Landy et al., 2013; Wolf and Younie, 2019) can be a good stimulus to introduce new approaches that favour a sound-based approach to music and thus enable exploration, experimentation and electroacoustic creation.

As Kaschub & Smith (2014) and Dwayer (2016) suggest, teacher candidates with a background in Western music may have little knowledge of other styles, and this may be inappropriate for teaching music in the classroom. As mentioned previously, this type of teacher training generates certain tensions by showing musical experiences that are disconnected from the interests of students (Allsup, 2016; O'Neill, 2015) where musical purposes are prioritised over educational ones (Regelski, 2012). The intervention proposed in this study aims to overcome some limitations from an integrative and encompassing approach, with a consideration of musical practices from informal learning (Green, 2008) to unusual styles such as contemporary music more focused on experimentation and electroacoustic creation (Holland, 2015; Landy, 2019).

For all these reasons, we hypothesised that the development and application of new didactic approaches based on sound through technology can help to broaden the identities of primary teachers in initial training by providing value and new didactic possibilities from the incorporation of new creative approaches to musical learning. The study aimed to investigate the perceptions of music teachers in training in order to analyse their beliefs and values towards the model underlying the intervention carried out, which combines creativity, an open sound system and the use of technology as a tool for creation.

Method

Design

The subject in question corresponds to the subject of Music and ICT, a compulsory semester subject of 45 teaching hours, within the itinerary of the syllabus of the degree course in Primary Education Teacher Training, with a specialisation in music education. This 4-year degree of 240 ECTS credits (European Credit Transfer and Accumulation System) has been taught since 2011 at the public University of Valencia, where this research was carried out. At this institution, the specific music education subjects required to be a music teacher add up to a total of 30 ECTS in the curriculum.

Participants

The study included 44 third-year students (67.9% female and 32.1% male) from the aforementioned degree programme who were between 20 and 23 years old in 2020–21. In total, 14.3% of the participants claimed to have previous music knowledge and studies (playing an instrument, music theory, history, analysis and harmony). Of these, 3.3% had a music degree (higher conservatory or university), 76.8% had an intermediate degree (conservatory), 13.3% had obtained an elementary degree and 6.12% were self-taught. Participants were asked to sign an informed consent form in order to collaborate with their data in this research. This included the terms of the research, the relationship between the research and the content, method and evaluation of the subject matter, as well as the privacy of the data obtained and the right to withdraw. The research was subject to the ethical norms of teaching at the centre where the intervention was carried out and did not require authorisation from the ethics committee, as the subject matter is taught by the researchers who authored this paper and forms part of their teaching duties.

Context

The intervention took place in the ARTSLAB, a laboratory with different spaces where digital technology is combined and integrated with other more analogue elements in order to foster

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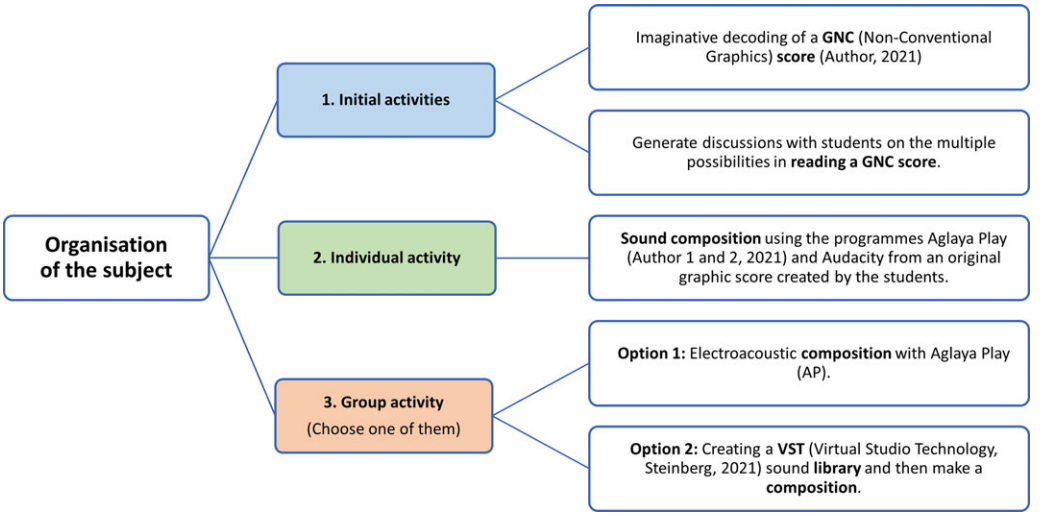

Figure 1. Activities of the subject Music and ICT.

creative art interactions. The study was developed within the 45 h of the subject and sought to encourage experimentation and sound exploration based on the manipulation and experimentation of simple objects (springs, boxes, bottles) and musical instruments that are played in a non-conventional way. Such explorations allow the introduction of recording techniques and sound manipulation. Likewise, this LAB concept seeks to break away from the idea of the monofunctional classroom to open up towards more of a *maker* concept where teamwork with a multidisciplinary approach prevails. The students' previous experiences place them in other types of spaces where an individualistic vision of learning prevails.

Description of the intervention

The intervention was articulated based on the competencies designed in the teaching guide (general and specific). The intervention approach adopted three elements: 1) SBM creativity (Landy, 2007; Holland, 2015; Holland & Chapman, 2019); 2) music technology; and 3) music creativity and its pedagogy in the school setting.

Projects and activities

The contents developed in the subject were integrated using the Technological Pedagogical Content Knowledge framework (Koehler et al., 2015; Gall, 2016; Tejada & Thayer, 2019; Murillo et al., 2021). The learning activities were grouped into four projects following the Project Based Learning pedagogical strategy (Kokotsaki et al., 2016) (Figure 1):

Once the initial activities had been carried out, the course was structured into two projects: an individual and a group project to choose between two proposals (see Figure 1). As an individual project, the students proposed a first sound composition based on an original graphic score created by them. This first sound creation also served to familiarise them with different digital tools such as Aglaya Play (AP) (Murillo et al., 2021) and Audacity, as well as to encourage experimentation and sound exploration.

In terms of group work, the first proposal to be chosen was to create an electroacoustic composition using software specifically designed for composition: Aglaya Play. The activities were: 1) A phase of exploration and selection of sound materials and their transformation through experimentation. 2) Group decision-making in the selection of a theme that guided the structuring

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of the sound ideas. 3) A performance of the work created by the members of each group (music, image and movement) whose sound component was controlled by the members of the group through an app for mobile devices associated with the AP software.

The second elective project consisted of the creation of a VST sound library (Virtual Studio Technology; Steinberg, 2021) from sounds sampled by the members of the group using hardware recorders and the creation of an electroacoustic composition using these libraries. For this purpose, the free version of Kontakt (Native Instruments, 2021), Zoom N4 recorders and software for creating, playing and editing samples were used. The activities were: 1) The selection and recording of sounds based on the exploration of different sound objects. 2) The creation of two types of VST libraries, one with the original sound and the other edited with the addition of sound effects. 3) The creation of a collaborative sound composition using the libraries created.

Evaluation

As instruments for the evaluation of the intervention, the following were used: 1) a product rubric with 11 criteria using 5-point ordinal scales for the results of the work projects; 2) an individual self-report as a final reflection of the whole learning process; 3) group reports; 4) discussion groups on the work carried out during the development of the projects.

Analytical categories

Once all the information had been collected from the students (see below), free coding was carried out with the support of the Atlas.ti v.8 programme. From these codes, four categories were established to organise the results. The most relevant data from each category are shown in section 4. Results and discussion. The codes ordered by categories can be seen in Figure 2:

Instruments and techniques

In order to collect the information related to the object of this research, a preliminary questionnaire, a self-report, discussion groups, a final subject report and a product rubric were drawn up to assess the following concepts: previous selection of sounds, originality, extra-musical connections, timbre treatment, creative use of digital tools, group work, time management, assimilation and use of concepts, public presentation, originality in the presentation, in-depth study and reflection in the final report.

The pre-questionnaire was designed to characterise the participants. It included 22 items, some open-response and some closed-response, grouped into three dimensions: demographics (three items), composing experiences (10 items) and experience with music and technology (nine items).

The self-report included 11 open-ended items in which students were asked for their perceptions of the subject. These items were aimed at eliciting individual reflection on the teaching-learning process carried out in the subject by providing information on positive and negative perceptions, changes in the possibilities of using technology, personal objectives achieved, assessment of teamwork and the value of technology in the creative processes after the experience. The information provided was qualitatively analysed using these informative indicators as categories of information and were used to construct the narrative of the interpretation of results.

In order to triangulate the perceptions of the self-reports, nine focus groups were held, one for each working group, which addressed open themes predefined by the researchers themselves according to the needs of the research. These themes (elements to be highlighted in the subject, collaboration, tensions, discoveries, problems, challenges and difficulties on an individual level, transformations in the perception of the possibilities of ICT and concepts of contemporary music education) served as a guide for the discussion. Each group had a student as moderator, except for one of these groups, which was moderated by one of the researchers following the same guidelines as in the other groups. The information obtained in the student discussion groups was contrasted

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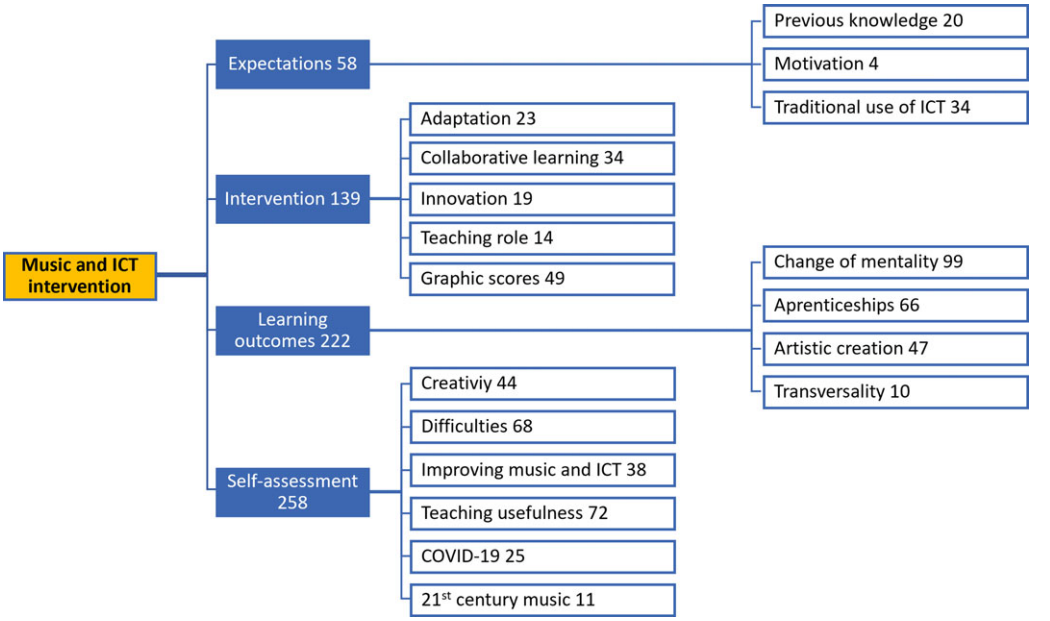

Figure 2. Categories and codes of analysis together with the number of analysis units.

with the discussion group moderated by the researcher and triangulated with the information from the self-reports.

Lastly, a final report was requested from each student and each group as part of the individual and group projects, respectively. This document served to deepen their reflections and to inquire into details and questions beyond the description of the processes carried out in the different learning activities.

Procedure

To help initiate the projects, the researchers, who were also teachers of the subject, drew up basic guides as a framework for the students that allowed them the freedom to follow the different phases of the projects openly. In addition, they were provided with continuous support and supervision by the teachers throughout the project development process, helping them to resolve problems that arose during the course of the projects.

Prior to the intervention, the pre-questionnaire mentioned in the Instruments section was administered. The work sessions took place during the second semester, at a rate of two lessons per week of 90 min from January to May 2021. Due to the health issues caused by COVID-19, the faculty organised the teaching in such a way that each half of the group-class attended face-to-face classes once a week instead of twice a week. While half of the group attended face-to-face classes, the other half continued working on the project or asked for tutoring from the subject teacher. Shortly before the end of the intervention, the focus groups were conducted and videotaped with the corresponding consent. At the end of the intervention, students were asked for the final products, the self-report and the final report on the subject.

Results and discussion

In the presentation of results, the data obtained from the self-reports, group reports and the different focus groups have been triangulated. To maintain anonymity, codes referring to the

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document number and the identification of the unit of meaning are used. The results and discussion are presented together within each analytical category in order to facilitate the critical reading of the data obtained.

Expectations

In general, most students had very low expectations of the subject. Their perceptions were related to a traditional view of technology, with a utilitarian, technically oriented concept prevailing, linked to Western notation music software that reinforced traditional musical approaches (Savage, 2010). In this sense, previous educational experiences, determined by the low technological competence of Spanish music teachers, could be one of the main causes (Calderón-Garrido, 2020).

> I think that my expectations were surpassed and I admit that it was a relief to know that I was wrong in thinking that we would be working with conventional notation programmes. We have certainly worked on much more interesting aspects of music than I had imagined (2:366). Up to this point I had only used the technologies for editing work. (1:29)

However, this belief about technology gradually faded, presumably due to an understanding of the possibilities of creative use of technologies:

> I feel that I am now more capable of approaching a musical creation using this technology [. . .] I have learned a lot about it, and I would continue to experiment and make different musical creations (1:80). I didn't expect to have the opportunity to create sounds, modify them and even create something in sound together with my classmates. (1:108)

In this way, the subject allowed the students to dispel the misconception that in order to create music, it is necessary to have a special skill or very advanced studies. Consequently, this experience has shown them that there are new ways of making music in which, without prior musical studies, anyone can be able to create their own music (Holland & Chapman, 2019).

> I have always thought that creating musical pieces was a job that could only be done by specialised people with professional programmes and materials, but the reality is that everyone can create, and you don't need a great deal of knowledge or materials to be able to create a free composition. (2:353)

As some authors point out, a creative approach to electroacoustic creation could lead to more inclusive approaches in the music classroom (Wolf and Younie, 2019).

Intervention

In the face-to-face teaching phase, technical problems were quickly solved, and the environment improved significantly thanks to access to resources and the constant support of the teacher. 'They are simple applications, but you need practice to understand them, so at the beginning, when the classes were online, it was a little more difficult' (2:225). This finding is in line with other work suggesting that lack of resources can be a major barrier to the appropriate use of technology (Bauer & Dammers, 2016; Gall, 2013; Purves, 2012; Bahcivan et al., 2019).

According to some students, the face-to-face classes facilitated a greater understanding of the approach that was reinforced by a greater dedication to exploration, sound creation and the use of technology. In this sense, the accompaniment of creative processes by the teacher is of vital importance (Juntunen, 2014), as the creation of participatory and collaborative environments between teachers and students can make a difference in the consolidation and development of

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creative actions (Brown, 2007; Kladder & Lee, 2019) in a complex context. 'Thanks to our teacher's explanations and peer support in class, I have been able to see that I am capable of this and much more' (2:365).

The performance of technology-mediated tasks in a context that integrates content has favoured greater student involvement, which could be interpreted as a sign of increased motivation. Digital tools, used in an integrated way in the exploratory and creative processes, have strengthened creative strategies and resources, acting as a kind of cognitive amplifier. This integrative approach has favoured the focus of intervention to be centred on the tasks and processes of exploration-creation, instead of one centred on technology as the driver of the activities, which shifted the importance of technology to the role of mediator and not the centre of the contents (Virtaluoto et al., 2021).

The following comments made by a student are very significant, clearly reinforcing this idea of the invisibility of technology and of a change that allows us to talk about technology at the service of didactics and as a facilitating tool:

> For me, technology was not the main part of the subject. I realise that technology was very present in everything, but what was most significant was the creation of sound, experimentation and this new way of understanding music education. From my point of view, technology has helped me to enrich this new vision, but for me the technology itself wasn't the end goal. It has helped me to create and experiment and I consider it a very useful tool offering new possibilities for music education and innovation (1:51).

As already mentioned, integration with disciplinary content can reveal new ways of implementing technology in music classrooms and favour more solid and successful learning (Bauer, 2013; Tejada & Thayer, 2019; Murillo et al., 2021), thus generating greater self-confidence in future teachers.

Learning outcomes

Students mentioned the broadening of their sound perceptual abilities, their curiosity and their attention to the phenomenon of sound, and that in some way the uses of technology applied to their proposals have helped in the construction of this perception. Along these lines, one student comments:

> I had never thought of using ICTs to make this kind of music and generate compositions from sounds that we often don't even pay attention to. So, this has helped me to pay more attention to the sounds around us. I also think that the use of technology has been fully integrated in an innovative way. (1:11)

As has been mentioned repeatedly in this section, the integrated use of technology together with disciplinary content and pedagogical strategies has favoured changes in attitudes and overcome resistance to the use of technology in learning processes (Bauer, 2013). Furthermore, it has overcome a technical and system-centred vision to assume a 'natural' concept of technology (Bruce & Hogan, 1998), assuming its invisibility, but without detracting from its usefulness, both as a tool for ideation (experimentation and exploration) and for organising musical production (King, 2018). In some cases, there is a clear evolution of the students that allows them to transform their previous ideas in the use of ICT towards new ways of approaching music education with possibilities and approaches that allow them to enrich their background and autonomy:

> I had not imagined approaching the music subject in this way; I had never seen it before, but the truth is that it is a way that has gradually won me over; I see it as one of the best ways of

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> approaching the music subject at school. I think that if I have the slightest opportunity to do so, I will use ICT creations in my music lessons. (1:44)

The processes of sound creation through ICT have brought a more critical and reflective view of its possibilities reinforcing the SBM approach (Holland, 2015; Holland & Chapman, 2019) through experimentation, research and constant innovation in their learning processes.

> The playing with sound as has been done in this subject is an excellent way to bring the world of music closer to the youngest children, because music is sounds. Sound should be the protagonist above theoretical conventions of musical language, since the school in which I have grown up or have done my practical work, the conventional and theoretical vision has always overlapped the other. The role of the learner in creation and experimentation should be taken into account in all areas of knowledge, this means an active role where the learner discovers through experimentation. (1:56)

Perhaps part of the success of the intervention, repeatedly stated by learners, was that the technology used through a focus on sound did not require learners to have an in-depth knowledge of music theory to use it or to perform or compose it from the graphic scores (Holland & Chapman, 2019). Regarding the latter element, one student notes that 'the free and creative language of graphic scores makes music accessible to everyone, regardless of musical studies or theoretical background' (2:74). Furthermore, the use of graphic scores allowed students to focus their attention on sound, specifically its parameters, structures and creative use. Students were able to explore other possibilities without having to resort to musical notation.

However, some students also showed some insecurities about carrying out this type of experience in their future teaching careers. In this sense, one student commented:

> Although my experience in this subject has been very good, I have some doubts about being able to carry out these proposals in a school. I have done an internship in schools where we didn't have any computer equipment to work with. In addition, the use of technology, and in such a creative way, has only been addressed in this subject during this degree programme. (1:7)

Finally, students taking advantage of the idea that ICT helps to democratise music (Delalande, 2004) have considered continuing their education based on this educational approach with the aim of applying it when they start teaching, however complex this educational model may be at the beginning.

Self-assessment

The students value the work they have done in the subject of music and technology. From some of their accounts, it can be deduced that the approach adopted in the subject has allowed them to overcome, in some cases, certain resistance towards technology. Moreover, the use of technology focused on creative tasks has helped them to break down prejudices about the meaning of what they understand by music, broadening this concept considerably:

> I think it [the course] has been very enriching and has brought another point of view to the figure of the music teacher. It has broken down the schemes and prejudices that we ourselves had (1:262).

In relation to group work, although difficulties related to the disparity of ideas are reported, the difficulty in establishing a common consensus in some decisions and in the multidisciplinary approach to projects is considered a strength that will help the student teachers to better manage their teaching performance in the future. This is based on the ability to learn from differences with

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their peers and the hybridisation between different areas of knowledge. New ideas and their connection are also likely to be generated through interdisciplinary work in collaboration with other art forms (Ruthmann & Dillon, 2012), which would facilitate a strengthening of the students' identity:

> By chance, we were a group of people who were very competent in the different fields that were being worked on in the subject and the specific work, which meant that the work went very smoothly, and we all contributed a lot to the project. In addition, the fact that we are five different people, not always the same one, produces better ideas and allows us to discover points of view that we had not thought of at the beginning (2:57).

In general, and after the experience carried out, there is a predisposition towards more intensive use of ICT applied to more creative and less conventional uses than those that make up their previous experiences. 'We are not usually aware of all the sounds that surround us during the course of a day, and thanks to this subject we have been able to become aware of this fact in order to use it as a musical and creative resource' (2:289). In this case and in general, the students have achieved a better understanding of the tools, as they have been able to contextualise them through diverse and unexpected uses arising from the tasks and activities of the different projects. This has given them the opportunity to reflect, act and explore in a more active and imaginative way:

> This subject, apart from learning a lot of things about ICT, and learning new applications to enjoy music, has helped me to bring out my artistic and imaginative streak that had been hidden for a long time. It blew my mind! (3:29).

In the same vein, Himonides & Purves (2010) see technology as an enabler for researching, monitoring, recording, celebrating and participating in musical development. 'ICT is therefore a very good resource to get out of our comfort zone and explore new musical typologies' (2:359). Also, many of the students agreed that this subject has allowed them to work on concepts so typical of the arts such as creativity and imagination, but that music education sometimes does not give them the importance they require.

Conclusions

The intervention carried out in the subject of music and technology based on electroacoustic creation and sound experimentation from an SBM approach has enabled students to become aware of more creative and innovative ways of learning that can be determinant in their future as teachers. The results also suggest that their beliefs can be transformed towards a more reflective and open attitude towards the use of technology by developing processes of experimentation and creation through sound. Underlying these beliefs and values is a concept of music and music education that channels almost all their actions towards outcomes linked to the traditional and known. However, when the tasks developed are deployed through exploration, experimentation and sound-based creation, their perceptions change to give way to a more open attitude towards what can be accepted as music and, consequently, have allowed them to broaden their imaginaries beyond the traditional concept of music.

Taking into account these kinds of concepts in the design of educational proposals involving the use of technology can be important to redefine and broaden students' visions. This could generate new strategies for the improvement of musical learning and the development of student-centred creativity.

Students' learning models, linked to traditional models where the tonal prevails, have been extended towards new territories of sound, also improving their musical listening skills. This has

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also been possible due to the aforementioned: the openness of the tools used (sequencers, libraries, sound editors, recorders) and their non-dependence on theoretical musical knowledge, leading to greater exploration and exposure to new sounds more in line with contemporary sound languages. When it moves beyond a single tradition, curiosity expands musical perspectives and enables musicians to better grasp the character of the traditions of which they are practitioners from their own and from others' perspectives, although occasionally this process could be unsettling and discomforting to learners (Jorgensen, 2021).

It is worth noting that the freedom to experiment with the processes of creating learning was part of the teacher's strategies and helped the students to overcome fears through greater management of uncertainty. This allowed the students to be more self-confident, to seek new challenges and to offer ideas in their sound proposals without being focused on the normative criteria of qualification.

Although the data generated were of a qualitative nature through self-reports, students greatly appreciated the activities and projects done on the subject. However, some negative aspects included some students mentioning doubts about the implementation of this approach in schools. This could be due to their experiences during their internship, where their tutors sometimes had no pedagogical training in the use of technology or the classrooms did not have sufficient resources to be able to work in the right conditions.

This study has two main limitations. The first is that this intervention was conducted during the COVID-19 pandemic when the ARTSLAB was closed for the first classes, making it impossible to have a direct experience with the materials available in this space. The second limitation is that we are aware that the 45 h of the course may not be enough to bring about lasting change. In future research, it could be of great interest to design studies that allow us to delve deeper into the professional contexts of these students with the aim of observing and analysing which elements guarantee and favour a continuity in positive attitudes towards the creative use of technology or, on the contrary, which elements of practice hinder the predisposition towards an innovative and integrated use of technology.

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