

**ARTICLES****Technological resources for the initial training of Music teachers:  
an intervention in the Spanish university context****Recursos tecnológicos para la formación inicial del profesorado de Música:  
una intervención en el contexto universitario español**Elena Berrón Ruiz<sup>1</sup>

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**Abstract**

In the teaching of music, the evolution of technology and computer technology has led to new methodological practices for classroom work. In the field of higher education, we present a qualitative research project based on the application of different digital resources and tools in the subject of “Instrumental Training”, which is part of the Bachelor's Degrees in Early Childhood and Primary Education. Its general objective is to determine the usefulness of ICT to favour the initial training of Music teachers, which, in turn, is specified in two specific objectives: to find out the students' perception of the technological applications and resources used in their learning process, and to assess their inclination to use ICT when they work as Music teachers. Data collection has been carried out through various techniques and instruments, including questionnaires, a focus group discussion and document analysis. Among the results, it is worth highlighting the innovative nature of the use of ICT in the classroom, making it possible to make better use of class time and boosting pupils' autonomy and motivation in musical learning.

**Key words:** teacher education; music education; educational technology; Music teachers.

**Resumen**

En la enseñanza de la música, la evolución de la tecnología y la informática han impulsado nuevas prácticas metodológicas para el trabajo en el aula. Desde el ámbito de la educación superior, se presenta una investigación cualitativa basada en la aplicación de distintos recursos y herramientas digitales en la asignatura de “Formación Instrumental”, perteneciente a los Grados de Maestro en Educación Infantil y Primaria. Su objetivo general consiste en determinar la utilidad de las TIC para favorecer la formación inicial del profesorado de Música, el cual, a su vez, se concreta en dos objetivos específicos: conocer la percepción del estudiantado sobre las aplicaciones y recursos tecnológicos empleados en su proceso de aprendizaje, y valorar su inclinación a utilizar las TIC cuando ejerzan como docentes de Música. La recogida de datos se ha llevado a cabo a través de distintas técnicas e instrumentos, que incluyen cuestionarios, un grupo de discusión y el análisis de documentos. Entre los resultados, cabe destacar el carácter innovador que ha supuesto la utilización de las TIC en el aula, posibilitando un mayor aprovechamiento de las horas de clase e impulsando la autonomía y motivación del alumnado en el aprendizaje musical.

**Palabras claves:** formación del profesorado; educación musical; tecnología educativa; profesorado de Música.

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## 1. Introduction

Throughout the 21st century, information and communication technologies (hereinafter, ICT) have emerged as an instrument of great social influence. As Bringué and Sádaba (2009) report, the vast majority of Spanish adolescents between 10 and 18 years of age have a computer at home and, before the age of 10, many of them use mobile phones and access the Internet on a regular basis. At this age, one of the most common applications of these tools is their use for musical purposes.

Educational institutions, as an essential part of society, are constantly evolving to adapt to emerging demands, so they are no strangers to these new technological tools and devices, which must be incorporated into classrooms to promote digital literacy among students (Sá, & Serpa, 2020), which necessarily requires adequate prior training for teachers (Gutiérrez *et al.*, 2022).

There are numerous frameworks around the concept of digital competence, both for learners and teachers. With regard to the latter, the European framework for the digital competence of educators (Redecker, & Punie, 2017) and the ICT Competence Framework for Teachers (UNESCO, 2019) stand out in Europe.

In the Spanish educational context, the current *Organic Law 3/2020 (LOMLOE)* emphasises the importance of using ICT in the teaching-learning process to favour the work of teachers in the performance of their duties, as well as to foster motivation, autonomy, teamwork and the development of communicative and technological competences of students. This integration of technology is contemplated in the *National Plan for Digital Competences* (Gobierno de España, 2021), which includes two lines of action aimed specifically at the educational sphere: the digitalisation of education and the development of digital competences for learning in education. The Ministry of Education and Vocational Training's *Plan for the Digitalisation and Digital Competences of the Education System (Plan #DigEdu)*, in which great importance is attached to teacher training, is the concrete expression of this digitalisation at the level of the Ministry of Education and Vocational Training. In this regard, it should be noted that the *Reference Framework for Digital Competence in Teaching (MRCDD)*, developed by the National Institute of Educational Technologies and Teacher Training (INTEF, 2022), is currently the reference document for educational administrations in the diagnosis and improvement of the digital competence of Spanish teachers, and its update takes into account the European framework established in the *Programme for the Improvement of Digital Competence in Education #CompDigEdu*, associated with the *Next Generation EU* funds. The ultimate goal is to integrate the use of digital technologies in an appropriate and effective way in the teaching performance and that results in the achievement of digital competence of students, to facilitate their full development and integration into society. The MRCDD consists of 6 levels of progression (A1, A2, B1, B2, C1 and C2), 6 areas (professional engagement, digital content, teaching and learning, assessment and feedback, student empowerment and development of students' digital competence) and 23 competences (reflective practice, creation and modification of digital content, peer learning, self-regulated learning and assessment strategies, among others), each of which includes different achievement indicators.

In the context of higher education, where the research in this article was carried out, Díaz (2013) points out several advantages of ICT for learning, as they allow rapid access to

information, offer the possibility of developing verbal, graphic and audiovisual expression skills, favour communication between teachers and students, promote group learning and facilitate the development of more personalised teaching. There are also several studies that show the usefulness of technology as a cognitive tool to facilitate executive processes, to help students to think (Herrington, & Parker, 2013) and to exercise their memory (Linden *et al.*, 2016).

In the specific field of the initial training of future Music teachers, the subject of the study presented, not only is it necessary for teachers to have adequate digital competence in order to be able to integrate ICT into their training plans, but it is also necessary to ensure that students also develop it and know how to manage it in their future professional practice (Fontes *et al.*, 2021). In this respect, it should be noted that, in music education, singing, movement and instrumental performance are priority contents, whose work can benefit from specific digital resources, such as karaokes, sound bases and accompaniment softwares, video dances or own recordings. Similarly, listening and music creation can be optimised with multimedia materials or various score, audio and video editors. There are even numerous websites that offer very enriching resources for the music classroom, combining textual information, images and sounds and allowing interactive practice. All of this can be taken advantage of by Music teachers, in their initial and ongoing training or in their teaching activity, and integrated into the classroom to be used by students (Cremata, & Powel, 2017). The advantages of digital technology for music education are numerous, as it allows new ways of creating music (Wise, 2016), increases student involvement in the educational process (Serrano, 2017), facilitates the presentation of information, contributing to the development of attention and the capacity for expression (Calderón *et al.*, 2019), enhances creativity (Murillo *et al.*, 2019) and favours both autonomous work and the performance of musical activities in groups (Cózar *et al.*, 2015).

However, despite the potential of technology as a tool in the service of education, it is a mistake to believe that simply incorporating technology in the classroom improves the quality and effectiveness of learning and enhances students' digital competence (Stowell, & Dixon, 2014). In fact, the study by Haning (2016) shows that almost half of the students did not feel prepared to use technology effectively when teaching Music. Equally noteworthy is the anthology by Eiksund *et al.* (2020), which presents research projects that examine the intersection between music, technology and education from a variety of perspectives, questioning educational practices at school and higher educational levels, as well as the aims and content of music education.

Technology, by itself, does not lead to processes of innovation and improvement in teaching and learning; rather, its effectiveness depends on the methodology adopted and how it is used in the educational process (Casanova, & Serrano, 2016). Therefore, in the pedagogical practice of teachers, it is not only necessary to review how they use ICT, but it is also important to reflect on the why and what for. As Fontes *et al.* (2021) point out, "Music teachers must be aware, reflecting on their initial training, of the repercussions that digital tools have on educational environments" (pp.8-9), which implies that they must know them, apply them and evaluate their usefulness, in order to be able to integrate them, subsequently, in their didactic proposals. Similarly, in their professional practice, Riaño *et al.* (2022) point out that "if a teacher finds technology attractive, he or she will tend to develop the digital competences necessary to use it in the classroom and will be concerned about being up-to-date" (p.19). In any case, the use of digital resources is associated with the application of active educational methodologies, which

are those in which students play a decisive role in the construction of their own learning (Berger, 2020).

The situation described above justifies the need to take on the new challenges posed by the digitalisation of the educational process in the initial training of Music teachers, since, when technology is used appropriately, there is greater control and progress in musical learning (Vasil *et al.*, 2018). The use of ICT for playing songs or accessing information about musical content on the Internet is a common practice in the classroom, but its application to work on other content in this area, such as learning to play instruments (piano, ukulele, flute, reed instruments...), carrying out collaborative musical work or facilitating group performances is a challenge that has been addressed in this research.

As background work directly related to it, it is worth highlighting the work carried out by Tejada and Thayer (2019a) and Thayer *et al.* (2021), carried out in the initial training of future Music teachers in Secondary Education, in a Chilean university and in a Valencian university, respectively, as well as the work of Tejada and Thayer (2019b), developed in the Primary Education Teacher Training Degree, with students of the mention in Music Education. In all of them, the starting point was the scarce previous training in technology that the students had had in music education subjects, detecting that "the objectives, contents and activities were focused on decontextualised information of the teaching processes of particular hardware and software, maintaining little relation with musical and pedagogical contents" (Thayer *et al.*, 2021, p.5). Therefore, pedagogical interventions for music teaching are developed, based on the use of active methodologies and the adaptation of the theoretical framework of integration of disciplinary, technological and pedagogical contents called TPACK, with the aim of favouring the understanding of technology and its application in the classroom. These studies show that the characterising components of the intervention can contribute to a more reflective and effective planning of ICT use in the music classroom. Furthermore, they emphasise that technology helps to consolidate the professional profile demanded of future teachers.

Methodologically, similarities can be observed between the works of the aforementioned authors and the approach of some of the educational proposals implemented in this study. The similarity can be found especially in the activities referring to composition and group musical performance, supported by PBL and collaborative work, in which the aim was for students to apply ICT, to personally experience their educational usefulness and assess their pedagogical potential in their future teaching practice. On the other hand, the proposals for individual work presented in this article are characterised by giving the student the freedom to carry out self-regulated learning, nourishing their motivation through the use of gamification strategies, with the aim of increasing their protagonism and responsibility in the educational process.

In view of all the above considerations, this article presents a study carried out in the field of higher education with future Music teachers, based on the implementation of an educational proposal that promotes the use of ICT, as it was considered necessary for them to learn how to apply them and to understand their scope in music education, in order to subsequently respond to the general objective of the research, which is to determine the usefulness of ICT to favour the initial training of Music teachers. This general objective is, in turn, specified in two specific objectives:

- To find out the students' perception of the technological applications and resources used in their learning process.
- Assess their inclination to use ICT when teaching Music.

## **2. Method**

In this section, we will address the methodological aspects that have guided both the research process and the educational intervention in the classroom.

### **2.1. Design**

The work carried out is of a qualitative-interpretative type, as it is descriptive and explanatory in nature, and pursues understanding by conducting the exploration from the perspective of the participants themselves (Hernández, & Mendoza, 2018).

The research method used was the case study of a specific group of students, in which an educational intervention was applied. Therefore, the case study constitutes the umbrella for the research based on the intervention developed in the classroom, being necessary to consider characteristics of both methods, in order to achieve an optimal adaptation to the objectives pursued. Following Stake (1998), the characteristics of the case study considered in this work include its particular (unique), descriptive (richness and density) and heuristic (understanding and generation of experience of change) character. It is also a method that is based on the convenience of time, location and disposition of the informants (Valenzuela, & Flores, 2012) and that allows us to understand the individual or group, their situation and behaviour in the total configuration of the factors that affect them (Zabalza, 2011).

With regard to the characteristics of intervention-based research, the starting point is the conviction that "it is in intervention through teaching, through daily practice and permanent reflection on it that the educator can not only explain the new school realities, but can also transform them" (Benítez, 2021, p.10). Therefore, after an initial diagnostic phase, carried out through a questionnaire to determine the students' musical knowledge and previous experiences with active methodologies and ICT, the phases of design, implementation and evaluation of an intervention proposal for instrumental training followed, based on an innovative approach and with the aim of developing their digital competence. Moreover, as Remedi (2015) points out, it must be accepted that "in any intervention process, we work with meanings constructed and situated in a space and a place" (p.291) and that the interveners are also intervened by their own practices, because "as interveners they are affected and will be modified by the intervention" (p.291).

### **2.2. Participants**

The research was carried out in the 2021-2022 academic year with 13 students from the Escuela Universitaria de Educación y Turismo de Ávila (Universidad de Salamanca), who were taking the "Instrumental Training" subject, which is worth 6 ECTS credits. This subject is part of the 4th year of the mention in Music Education and was taken by students from the Bachelor's Degree in Primary Education (9), the Bachelor's Degree in Early Childhood Education (3) and

the Double Degree in Early Childhood and Primary Education (1). The student body was characterised by different levels of musical training, as several students had complementary musical studies at specialised centres, such as conservatories, academies or music schools, while others had only received their training in compulsory education. All of them initially signed an informed consent to participate in the research. In addition, they were informed that their personal data would remain anonymous and that they were free to leave the study whenever they wished, following standard ethical procedures for research involving human subjects. Also, before conducting the focus group, they were asked for permission to record, transcribe and publish their speeches in scientific communication reports. The subject teacher was also the principal investigator of the study.

### **2.3. Intervention design**

#### *Description of the educational intervention*

This research forms part of a more far-reaching project, in such a way that the educational process developed in the subject of “Instrumental Training” was based on the application of different active methodologies, as it was considered that the use of technology, in itself, was not innovative if it was not accompanied by a methodological change with respect to traditional practices in music teaching. The educational proposals developed and the active methodologies used in each of them were as follows:

A. Group educational proposals: to carry them out, the students were organised into teams of 4 or 5 students, of two types:

- Instrumental ensemble: the work was based on the methodologies of challenge-based learning and collaborative learning, and consisted of instrumentalising children's songs for school groups, following pre-established composition guidelines. Subsequently, they had to perform their musical interpretation and record it on video twice, with the team members changing instruments on each recording.
- Project-based learning (PBL) based on a percussion proposal: this second group work consisted of two parts. Firstly, grouped in teams and working collaboratively, the students had to create a proposal for body percussion/small percussion to be applied in one of the primary school grades. In addition to creating the score, they had to record themselves performing it musically. Subsequently, based on its use and teaching in the classroom, they had to design a didactic project framed within the PBL methodology, proposing activities that would allow for interdisciplinarity with at least three areas of knowledge, including the subject of Music.

B. Individual educational proposals:

- Instrumental practice of flute, ukulele and piano: the work on these three instruments was carried out using gamification strategies to increase motivation towards their study and facilitate self-regulated learning. Independent work patterns were established for the different instruments, which allowed students to determine their own learning routes. In this sense,

they could choose scores according to their abilities and interests from a selection provided by the teacher. By passing these scores, they could receive medals, points and bonuses, as well as access to challenges. For the teaching-learning process of the recorder, the flipped classroom methodology was also used, in such a way that the students initially worked on the different scores at home with the help of audio and video tutorials and then, in class, the difficulties encountered were discussed and group activities were carried out to consolidate what they had learnt. On the other hand, ukulele and piano work began first in the classroom with the teacher's guidelines and then the pupils continued their study at home with the help of audios and videos recorded during the classes.

- Instrumentation of a song: in this work the challenge-based learning methodology was again used, asking the students to create their own scores because, when practising as teachers, they had discovered that there was none adapted to their didactic objectives or to the specific needs of their students. Specifically, the challenge they had to overcome consisted of creating a score with the instrumentation of a popular children's song, achieving a suitable timbral, melodic, rhythmic and harmonic complementarity between the different school instruments used.
- Infographic or interactive card about a musical instrument: each student had to create an infographic or interactive card about an instrument, including a brief history, its parts, its most outstanding characteristics, the musical groups in which it usually participates, examples of the most representative works and authors, an illustration, a QR code giving access to an audio or video with a performance and the references of the sources used.

As for the evaluation system, the principles of formative evaluation, peer evaluation and self-evaluation were followed, establishing grading criteria and specific rubrics for the different proposals. For further details on the development of the educational intervention and its evaluation system, the reader is referred to the works of Berrón (2022a, 2022b) and Berrón and Arriaga (2022).

### *Implementing technological applications and resources in the classroom*

In this section, the main technological applications and resources used in the course are listed, together with a brief description of the use made of each of them for the development of the activities mentioned above:

- Audios and video tutorials showing the correct way to perform the instrumental interpretations.
- Microphone systems and amplification of the sound of the instruments, in order to favour group performances.
- The online tool *Genially*, to create a general interactive presentation of the subject. This presentation, developed collaboratively by the whole class, included the work guidelines for the flute, piano and ukulele, as well as the personalised progress of each student in the study of these instruments, which was reflected in different

medallions. This tool was also used by some students to create interactive instrument worksheets.

- The graphic design tool *Canva*, for making infographics with information about different musical instruments.
- The free score editing software *MuseScore*, for the development of instrumentation for school ensembles.
- The use of *smartphones* and tablets to record students' individual and group musical performances.
- *OpenShot*, an open access programme, for the subsequent editing of the videos recorded by the students.

## 2.4. Data collection tools

The research data was collected using the following techniques and instruments:

- Two questionnaires, validated by the judgement of two experts, who assessed their suitability to respond to the research objectives and indicated aspects for improvement that allowed the final versions to be made. The questionnaires were completed online by the students, respectively, in October, in case the need was detected to make any changes in educational practices<sup>4</sup>, and in December, to make a general assessment of the whole teaching and learning process<sup>5</sup>. In both cases, the answers provided were anonymous.
- Discussion group, which was carried out in December 2021 with all the students and the teacher-researcher herself, following a semi-structured and semi-directed model. It was videotaped so that no information was lost.
- Analysis of different documents: assignments, videos, student grades and e-mails.

This variety of techniques and instruments made it possible to triangulate the data obtained from each of them, guaranteeing the validity of the study.

It should be clarified that the diagnostic questionnaire completed by the students at the beginning of the course and mentioned above has not been included among the research instruments because its purpose was solely didactic, in order to plan the educational intervention according to the profile of the students.

## 2.5. Analysis procedure

### *Categories and thematic blocks*

The analysis process was carried out through the deductive establishment of categories, which were defined on the basis of the literature and the specific design of the intervention developed in the classroom. To facilitate the analysis, the answers given in the questionnaires were previously organised in an Excel spreadsheet and the recording of the discussion group was

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<sup>4</sup> Mixed questionnaire, available at: <https://cutt.ly/19GwctZ>

<sup>5</sup> Closed questionnaire, available at: <https://cutt.ly/0KMrFqg>



transcribed. The information obtained from the different techniques and instruments was then distributed into the following categories of analysis:

- Technological resources: collects information related to the didactic use of technology and digital devices, excluding specific programmes and applications.
- Softwares and applications: includes data on the use of different softwares in educational practice.
- Utility: this refers to the perceived use and benefits of ICT in education in general and in music learning in particular.
- Capacity building: contains information on the contribution of the proposals to the learning of music content and to the development of digital competence in teaching.

In turn, these categories were organised into two thematic blocks, which corresponded to the information needs derived from the objectives of the study (Table 1).

**Table 1.** Categories included in each thematic block

ICT applied in the educational process	ICTs in future professional practice
Technological resources Softwares and applications	Utility Capacity building

The analysis and categorisation of the qualitative data was carried out using the Atlas-ti programme.

#### *Instrument and participant coding system*

The instruments and the participants from whom the information has been extracted are identified using the coding system shown in table 2, which at the same time allows their anonymity to be preserved.

**Table 2.** Coding of instruments and participants

Instrument	Code	Collective	Code	Personal code	Page	Example code	Meaning of the code
Mid-course questionnaire	CMC	Students	Es	---	p.6	CMCEs, p. 6	Mid-term student questionnaire, p.6
End of course questionnaire	CFC	Students	Es	---	p.3	CFCEs, p. 3	End of course student questionnaire, p.3
Focus group	GD	Students	E	1	p.8	GDE1, p. 8	Focus group, student 1, p.8
E-mail	CE	Students	E	4	p.9	CBE4, p. 9	E-mail, student 4, p.9

As a clarification, it should be noted that, in the questionnaires, it was not possible to identify the answers given by each student, which is why they have not been assigned a personal code.

### **3. Results and discussion**

The presentation of the results will be structured on the basis of the two specific objectives set out in the research, as this is considered to be clearer for the reader.

#### **3.1 Students' perception of ICT applied to their learning process**

For the development of the “Instrumental Training” subject, various technological applications and resources were used.

In the questionnaire completed by the students halfway through the course, it was found that technology was being used appropriately, with comments such as: "We are using a wide variety of technological resources and all of them are proving very practical for me to learn the curricular contents better" (CMCEs, p.7) or "The applications and technological resources are appropriate and very rich and varied, which makes the subject more active and prepares us in technological competence" (CMCEs, p.7). Therefore, it was not necessary to make relevant modifications in their use, with respect to the initial planning. In the following, the participants' perception of each of the technological resources, applications and programmes used will be analysed.

##### *Technological resources*

All the students highlighted that the audios and videos showing how the instrumental interpretations of the different scores had to be performed had facilitated their study at home, coinciding with the contributions of Palazón-Herrera (2018). The observations made in the focus group also showed that they had been very practical: "We would stand here, rehearse a song, record it and you could watch it at home as many times as you wanted" (GDE12, p.41); "You are at home with your video, which you can repeat as many times as necessary, or, if you don't even need to watch it, you can come and record it" (GDE6, p.41).

With regard to the microphone and instrument sound amplification systems, in the questionnaire completed at the end of the course, 12 students stated that they had favoured coordination in group performances, so that the whole class sang and played at the same time. This aspect had already been highlighted earlier in an email to the teacher: "Hearing you sing and play the ukulele a bit louder than us helps me to tune better and not get lost in my playing" (CEE1, p.3).

Also, the use of recording devices for music learning, such as smartphones and tablets, was considered very or quite attractive and necessary for 9 students, sufficient for 3 and not enough for 1 student.

From these results, it can be inferred that when technology is used appropriately, there is greater control and progress in musical learning (Vasil *et al.*, 2018). Furthermore, the application of technological devices in the classroom has encouraged both teachers and students to be in tune with the reality of their environment, coinciding with the contributions of Gértrudix and Gértrudix (2014), who highlight their presence in the different areas in which they carry out their daily activities.

### *Softwares and applications*

The data relating to the tools and softwares used in the classroom are also significant, highlighting their innovative nature with observations such as: "From my point of view, it is innovation in education and in learning" (CMCEs, p.7), although, in order to make better use of their potential in musical learning processes, it has been necessary to link them to active methodologies (Riaño *et al.*, 2022).

Regarding the applications that were not aimed at working on music content, students highlighted that *Genially* was very interesting for the creation of interactive content (García *et al.*, 2022) and that *Canva* was a simple tool for the creation of attractive educational presentations.

As for the more specific programmes for music education, it is relevant that the editing of scores with MuseScore was very practical for almost all the students (only one student found it not very useful), as the programme "is very convenient, because you upload notes, download, and you can also listen to it and it encourages you [...] and you don't have to go around by hand" (GDE13, p.37). However, in the closed questionnaire, 4 students stated that editing videos with *OpenShot* had not been very suitable for Music classes, because they considered it not very intuitive and found it difficult to synchronise its use: "*OpenShot*, I don't know if it was my computer, but I had problems editing the video of the ukulele challenge, because it didn't come together" (GDE13, p.36). Consequently, it might be advisable to replace it with another software with a free version that has the same functionality, such as *WeVideo*, *Shotcut*, *Filmora* or *VideoPad*, since the generation of music videos by the students themselves is a resource of great educational value for the promotion of digital competence and the development of creativity (Gértrudix, & Gértrudix, 2010). Although the experience with the latter programme was not satisfactory for all the students, when asked whether any of the applications or technological resources used should have been omitted, the students indicated that, to a greater or lesser extent, they had all been appropriate for the educational process: "I think it was good. Besides, you have given us several ways of doing things" (GDE6, p.37).

As an aspect for improvement, when asked if there were any other technological applications or resources that had not been used in class and that they considered essential for their training in music education, one pupil made the following contribution:

The musicograms [...], which is a resource that is very practical in the classroom and that, perhaps, we don't know how to do it or how to approach it. [...] To have seen some of that would have been good too [...] with technology (GDE5, p.38).

### 3.2 Inclination to use ICT as Music teachers

As a starting point, it is worth noting that all the students recognised that, in recent years, the incorporation of ICT in music classrooms had increased and that it is no longer possible to do without ICT in the educational process:

In the end, we are going to have to live with ICT whether we like it or not [...] I don't think it is something that is open to debate: ICT in the classroom. In other words, it is something that is undeniable, that is going to be there and that I also think is necessary. [...] Nowadays, we don't know how to live without ICT (GDE5, p. 39).

In this case, future teachers were fully aware that "we have to renew ourselves and look at new technologies, because children are going to need them just as much as we do" (CMCEs, p. 7), also taking into account that "our students are digital natives and have been using technology since they were born" (GDE5, p.37).

#### *Utility*

The growing digitalisation in the educational field is justified by the fact that, on the one hand, the use of ICT by teachers facilitates the development of classes (Mato, & Álvarez, 2019), in which 12 of the participants surveyed agreed very or fairly strongly, highlighting, for example, "the convenience that you want to give your students an audio of anything, even some music, and it's just a click away" (GDE5, p.40). Therefore, they insisted that it was necessary to learn "to work with it and to get the most out of it and to really use it as a tool" (GDE5, p.39), and were grateful for having received training on different technological resources throughout the "Instrumental Training" course, with comments such as: "They are very interesting, as well as useful, some of which I didn't know about and, from now on, I will start to use more" (CMCEs, p.7).

On the other hand, digitalisation in the classroom favours student involvement in the educational process in general (Bonilla, & Aguaded, 2018), and in music learning in particular (Serrano, 2017), an aspect on which all respondents agreed, highlighting its contribution to the construction of meaningful musical learning. Furthermore, the students pointed out that "everything is already on the net, after all" (GDE13, p.40) and that, through ICT, educational materials on music could be easily accessed, so it was a question of knowing how to search, select, organise and work with the contents under study, for which computer resources were good allies. In this regard, it should be noted that, in this study, ICTs have allowed access to a wide variety of information, sharing experiences and learning among students and working individually and in groups regardless of distance or time (Díaz, 2013). Similarly, their impact on student motivation has been evidenced, with students stating that the classes were "very dynamic, enjoyable, interesting and constructive" (CMCEs, p.1), which coincides with the conclusions of Wise (2016), who emphasised their usefulness for learning better and with more enthusiasm, imbuing the process with an enjoyable and playful character.

Another positive aspect of ICT that all the participants recognised and which invites future teachers to use it for teaching purposes is its contribution to greater continuous communication between the members of the educational community, enabling the delivery of tasks and personalised accompaniment of each of the students, as the teacher could provide

immediate feedback and resolve any difficulties that arose in their learning process: "Do I have a doubt? I write an e-mail" (GDE13, p.41). In higher education, where this study has been carried out, this communication has taken place between the teacher and the students, but in primary education, it could be extended to families, with whom it is easier to contact using technology, either by email, educational platforms or specific applications designed for this purpose (Maciá, 2016).

Finally, given their profile as trainee teachers, the students also highlighted their usefulness for their professional future, making observations such as: "I find them useful resources both for university practice and individual study and for the future as teachers" (CMCEs, p.7). In fact, when selecting the resources to work with, the indications of Casanova and Serrano (2016) that "they should be used in a general way by the university professor in their classes, as a support for their teaching" (p.410) were already taken into account, but that "they had to serve later also as an end, as both their use and their didactic possibilities had to be explained" (p.410).

### *Capacity building*

The average marks obtained by the students in the different individual and group proposals implemented were very positive, as shown in the work of Berrón (2022a, 2022b), which shows their usefulness for working on the contents of the subject.

On the other hand, taking the current INTEF MRCDD (2022) as a reference, it can be seen that the educational proposals implemented in this work are especially related to the areas of digital content, teaching and learning, student empowerment and the development of students' digital competence, contributing to the development of different competences, at levels between A1 and B2, as can be seen in the achievement indicators shown in Table 3.

**Table 3.** Areas, competences, achievement indicators and levels worked with the educational proposals, according to the INTEF MRCDD (2022)

Area	Competence	Achievement indicators	Level
2. Digital content	2.2. Creation and modification of digital content	2.2.A1.3. Uses general authoring tools for the creation and editing of digital content (office automation, audio, image, video editor, etc.) and those specific to the subjects he/she teaches (score editor)	A1
3. Teaching and learning	3.1. Teaching	3.1.B2.2. It integrates digital technologies in its educational programming and practice in such a way that students have to make a plural, diversified, selective and responsible use of them to develop the proposed activities in order to achieve the learning objectives	B2
5. Empowering learners	5.3. Active engagement of learners in their own learning	5.3.A2.3. Uses, in a guided way, digital technologies to encourage motivation and active engagement of learners with the learning objectives of the area or subject	A2
6. Developing students' digital competence	6.1. Media literacy and information and data literacy	6.1.B1.1. Integrate into their teaching practice learning situations in which students must develop different strategies for searching, evaluating, selecting and organising information and data	B1
	6.3. Creation of contents	6.3.B1.1. Integrates into its teaching practice learning activities that allow students to express and transmit their ideas in a creative way, using appropriate digital tools, respecting copyright rules and licences	B1

The pupils' perception of the training acquired in the educational use of ICT was also positive. In this respect, it is worth noting that, in the questionnaire administered at the end of the course, all the students stated, to a greater or lesser extent, that ICT contributed to the achievement of the key competences of the curriculum, such as the sense of initiative and the competence to learn to learn, an idea reinforced by several comments included in the e-mails, such as: "Let's see what you think of the extras I have included when editing my video" (CEE6, p.15) and "I have learned to play by watching the tutorials you have provided us with. I am very happy" (CEE8, p.12).

Likewise, most students admitted that their digital competence and knowledge of ICT had improved in the "Instrumental Training" subject, with only three students disagreeing slightly with this statement. This greater mastery of technological resources was also evidenced in comments such as the one made by another student:

I have never used this application before (well, actually, almost none of the ones we have seen in class) and I have found it very useful. I feel that I am now better at working with the computer and I have lost a bit of my fear of technology, so thank you for teaching us how to do so many things (CEE4, p.13).

Therefore, the importance of technology for the development of key curricular competences, especially digital competence (Rodríguez-García *et al.*, 2019), has become evident, making students aware of why we use ICT and their educational benefits (Tejada, & Thayer, 2019a, 2019b; Thayer *et al.*, 2021), but also alerting them to their risks if they are not used appropriately (Berger, 2020). In this sense, it is relevant to highlight that all participants indicated that the knowledge acquired in class in relation to ICT will enable them to include them in their future professional practice.

Finally, the students considered that the "Instrumental Training" subject would not have promoted the same learning if ICT had not been used, recognising that "of everything we have done, we would have done half, because there would not have been enough time" (GDE13, p.41) or "I don't think even half, a quarter" (GDE12, p.41).

#### **4. Conclusions**

Throughout the 21st century, ICT has brought about important social changes that have transformed educational practices. As Stowell and Dixon (2014) point out, technologies are of great interest to teachers due to the wide range of possibilities they offer in the teaching and learning processes, but they are still underused resources in the field of music education, especially at higher education levels, which is the focus of this article. This is due to the fact that there are specific contents in the area of Music, such as instrumental practice, which are worked on following a traditional methodology, which reduces the role of the student to that of a mere score player, without any real involvement in the whole educational process (Montoya, 2017). Therefore, the proposal presented in this article, consisting of using ICT to train students instrumentally, is a great challenge that allows us to provide a new educational response, applying current methodological and technological resources.

The first specific objective of the research was to find out the students' perception of the technological applications and resources used in their learning process. In this respect, the results

obtained allow us to conclude that technology was used appropriately throughout the process, demonstrating the suitability of applying a proposal in which technology is the vehicle for more up-to-date instrumental training. On the one hand, with regard to the technological devices, it has been shown that these are resources that offer great possibilities in the field of music education. On the other hand, with regard to digital programmes and tools, it is relevant that the participants in this research highlighted the innovative nature of their use in the classroom, which shows that, although they are increasingly present in compulsory education, their use is still not sufficiently widespread in higher education, nor has it generated significant changes in pedagogical practices (Rodríguez-García *et al.*, 2019).

With regard to the second specific objective of the research, related to assessing the students' inclination to use ICT when teaching Music, it can be concluded that adequate digital training and the advantages experienced with the educational application of ICT justify the pupils' intention to use the digital tools and applications worked on in class, as well as other new ones that may arise, in their future professional practice. It is therefore necessary to increase knowledge about the didactic possibilities offered by ICT for music education and to recognise the importance of students' self-perception of their own technological skills, as both aspects favour their predisposition and confidence to use technology effectively in their teaching practice (Tejada, & Thayer, 2019a, 2019b; Thayer *et al.*, 2021).

Finally, after answering the two specific objectives, it is possible to address the general objective of the research, which is to determine the usefulness of ICT in favouring the initial training of Music teachers. In this respect, the experience developed allows us to affirm that the educational process would not have promoted the same musical learning if ICT had not been used, since, without the technological tools and resources gathered in this study, the planned activities could not have been carried out, which demonstrates their suitability for the established purposes. Moreover, the use of technology has made it possible to make more efficient use of class time, although it is inevitable that, when using digital programmes and devices, some difficulties sometimes arise which slow down teaching and learning. However, these difficulties can be used as opportunities to acquire new knowledge, so that overcoming them increases the digital competence and ICT knowledge of both teachers and students, coinciding with the contributions of Sánchez and Galindo (2018), who emphasise the importance of building cooperation networks, so that teachers can enrich each other by sharing their experiences.

As a future line of research that remains open after this study, it would be useful to analyse whether the incorporation of ICT in music education is accompanied by a renewal of the pedagogical practices of teachers at different educational levels or whether they are simply used as support for teaching work, without generating methodological changes in the teaching and learning processes, since, as Gutiérrez *et al.* (2022) point out, technological innovation is often confused with educational innovation.

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