

Studying Alone

How is IT affecting the manner we learn musical instruments

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Department of Information Science and Technology

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Resumo

A música sempre foi e sempre será um importante instrumento cultural, não obstante o país, ou região, onde esta é produzida. Ao longo dos tempos a aprendizagem das suas ferramentas sofrendo alterações, desde os tempos de Mozart até aos tempos de Michael Jackson, esta foi ensinada através de métodos tradicionais, numa pequena sala com um professor a demonstrar como se toca um certo instrumento ou como se lê uma pauta musical. Com o aumento de utilização da internet e de outras ferramentas tecnológicas abriram-se novas portas no que toca à aprendizagem musical, as pessoas passaram a conseguir aprender sozinhas no conforto de sua casa através de aplicações ou sítios web desenvolvidos primariamente com o objetivo de partilhar pautas de músicas ou como se tocam certas músicas. Neste contexto, o projeto pretende encontrar como a situação atual se encontra no que toca à forma como os indivíduos aprendem sozinhos a tocar os seus instrumentos. Para o alcançar foi realizado um estudo por questionário com alunos autodidactas, com foco em perceber quais as tecnologias e métodos que consideram como influentes, bem como as vantagens e desvantagens que lhes reconhecem.

Palavras-Chave: Educação musical, Música, Música na Web, Aplicações musicais

Abstract

Music has always been and will always be an important cultural instrument which is not affected by country or region where it is produced. Overtime, the learning of the tools required to make it has suffered alterations, either improvements or step backs. Since Mozart to Michael Jackson it has been taught through traditional methodologies, in a small room with a teacher demonstrating how to play a certain instrument or how to read a musical score. With the rise of the internet and other technological tools people now can learn from the comfort of their homes through apps or websites specifically developed with the intent of sharing musical scores or how to play certain music. The aim of the project, in this setting, is to find how the modern situation of music and most importantly how it is taught. To achieve the goal, a questionnaire was created for self-taught students, focusing on understanding how information technologies affect the class so as to facilitate musical learning and advantages and disadvantages.

Keywords: Music, Music learning, Music in the web, Musical apps

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List of abbreviations

GUI – Graphical User Interface

IT – Information Technology

PCA – Principal Component Analysis

WWW – World Wide Web

Chapter 1 – Introduction

The aim of this introduction is to contextualize the topic and provide all the information relative to the reasoning behind the chosen topic. This implies the questions and main goals of the research to be presented, how this research will be conducted and how it will be presented.

1.1. Topic context

Music has always been an integral part of human history and more importantly culture. For most it is a way of distracting themselves, bring up emotions, relax from hard times or remember good times. With the growing importance and existence of new information technologies music has become ever more accessible to anyone who has an internet connection. This growth is so extraordinary that it culminated in the appearance of new platforms that allow a person to learn by themselves, without the need for a teacher.

Evolution is the norm for everything in the world, the rule not only applies to the biology of living beings as well as to anything created by them. Music is not an exception, it has evolved through similar and at the same time distinct mechanisms when compared to biological life (Savage, Patrick E., 2019). One big step in this evolutionary process is education, and its own evolution, allowing different methodologies to settle and transmit what in fact matters, knowledge.

In general terms, music can be described as the use of our bodies or musical instruments to create and transmit sounds in order to perform a form of art. Such as other art forms, many if not all of its beginnings have been lost to history. So, we can only be thankful to be able to listen to Mozart and have infinite music with a simple internet search.

In the vast world of musical instrument teaching, an old perception is recurrent. For most of the documented history the basis of the teaching process for this type of tools is simple, there is a “master” and a student. The master’s job is to transmit the knowledge he/she gained throughout the years by practicing said tool and teaching it. These perceptions entice that many learn privately in what is commonly referred to as the studio setting, others study an instrument at school, some progress to higher education institutions (Daniel, 2006).

However, due to the technological evolutions reached by humanity over the past few centuries, the form a musical instrument is taught or learned today is not confined to the general perceptions. Various paths have arisen to allow for a person to fulfil its goal in the musical tools of work. The same old and known way of doing this is still widely common but in addition to it, people can learn and practice their craft by using the same products that evolution presented them. In this century more specifically, technologies such as internet data bases, video file sharing software's, social networks and purposefully developed apps have allowed for a greater choice of action when wanting to learn and/or practice in order to fulfil the goal of becoming a "master" in the art of producing music.

Several technologies have made an impact, whether positive or negative. Digital technologies, by being used in the context of music tools, can make jobs easier, tasks more efficient and what was previously impossible possible." (Brown, 2014). Examples of technologies such as this one are various. However, all kinds of technology can make an impact, with the biggest one being the internet itself, allowing for the appearance and creation of musical technologies that have been affecting the industry for centuries.

With the accessibility the new technologies have, with almost a billion educational apps being downloaded in the first quarter of 2020 alone or YouTube with over two billion users monthly, there is an almost infinite reach that can and has made a difference in the availability of information to people that do in fact want it. Technologies, in this area, have shown that they can impact and are in fact altering the same old perception of musical instrument learning.

With more and more people using new technologies to learn and/or practice, it is important to understand what the actual benefits are and what disadvantages might exist. From understanding what is growing, as a platform, and what is "losing the race" to the inherent question of the "Why?". It is this kind of information that the music community wants to find and treat so that this art form can reach everyone who wants it, therefore moving forward with the evolution of music itself.

1.2. Motivation and topic relevance

Choosing this topic could not be more actual. The evolution of learning technologies worldwide in the last few years in conjunction with the effects of the 2020 pandemic brought more awareness to the possibilities that new technologies can offer and are offering regarding learning.

Technologies are of the utmost importance, they are fully integrated to anything from music, from how it is created, performed, distributed, critiqued, and preserved, (Brown, 2014). Therefore, it seems relevant to study amongst these new technologies which have had and are having the biggest impact in music learning. More specifically the reasons why people choose to learn through informal methods or keep learning through the more “traditional” learning methods.

Furthermore, researching which technologies are actually being used for would help to make sense of why technologies have become such an integral part of the process in music, and specifically music learning. Digital technologies, by being used in the context of music tools, can make jobs easier, tasks more efficient and what was previously impossible possible.”, (Brown, 2014).

Lastly, and due to the latest trends, it does not appear that technology is going to stop being used any time soon, in fact its usage should only grow with the advance of time. So learning the actual state of the field in terms of user satisfaction would be helpful to perceive in what direction we can expect for this area of learning to progress in the near to mid future.

The importance of technologies should only grow, and by what history tells us, at an ever more rapid pace. Who knows what new innovations will appear and how these will affect music learning.

1.3. Questions and research goals

In the best interest of knowledge, we arrive at the main question of this dissertation: “How important is IT when learning a musical instrument?”. To reach for an answer, or who knows more interesting questions, some objectives were defined:

- Verify which are the most used methods are in the learning process;
- Verify what are the most commonly used technological tools in the learning process;
- Determine which are the most used apps in the learning process;
- Associate the used IT with the user satisfaction in the learning process;
- Ponder the advantages and disadvantages of the usage of IT in the learning process.

All said and done, in sum, the main mission of this dissertation is to help understand how technologies affect and have been affecting the teaching and learning of music, which technologies are more prominent, and how satisfied the users are with them.

1.4. Methodologic approach

The research in this dissertation is comprised by an online questionnaire, a more correlative solution to gather the information needed for the realization of this study.

The questionnaire, which as the base for its development had key indicators present in the literary review, was made making use of the google forms tool and it was distributed through social media and mouth to mouth in Portugal.

The collected data was treated statistically, making use of the SPSS tool, so as to characterize the sample, correlative analysis and principal component analysis (PCA).

1.5. Structure and organization of dissertation

The present work is organized in five chapters that intend to reflect the different phases until its conclusion.

The first Chapter introduces the subject of the investigation and its objectives, as well as a brief description of the structure of the work.

The second Chapter reflects the theoretical framework, called Literature review.

The third Chapter is dedicated to the Methodology used in the process of collecting and processing data as well as the methods of analysis used.

The fourth Chapter presents the Analysis of the results obtained, according to the methodology that was considered appropriate.

The fifth and last Chapter presents the conclusions of this study as well as the recommendations, limitations and future work.

Chapter 2 – Literature review

The aim of this chapter is to provide literature regarding the theme of this dissertation. It is divided among three subchapters, music (music through the ages, evolution and impact of technology in music), instrument learning (learning through classes, informal music learning) and self-taught instrument learning (self-teaching methodologies, learning through apps, learning through web courses and YouTube).

2.1. Music

2.1.1. Music through the ages

Music evolves, through mechanisms that are both similar to and distinct from biological evolution (Savage, Patrick E., 2019). From the beginning of mankind that one of the features that distinct us from other animals is the ability to speak, “there is a number of deep similarities between human music and language” (Fitch, 2005). As a consequence we eventually started trying to master the ability of creating and recreating different sounds, from the known hummingbird to crickets and all in-between. Music is a fundamental part of our evolution; we probably sang before we spoke in syntactically guided sentences (Schulkin & Raglan, 2014).

Stone points out that the evolution of music is directly connected to the evolution of society in human history, as they become more and more complex so does music. Music evolves from simple to complex within societies as they progress (Stone, 2007). From the creation of the first musical instruments made of stone and bone to the need of more entertainment post industrial revolution allowing for the creation of more complex music and therefore musical instruments.

In the second part of the 20th century music evolved at a rapid pace, new genres popped up every decade, instruments evolved and music became a more diverse subject thanks in part to the world’s globalization. One of the most consequential advances of the century that largely affected music creation was copyright. Musical education has also been affected in the past few years with writers such as (Savage, Patrick E., 2019) saying that “the world’s musical diversity is woefully under-represented at all levels of education.”

Copyright, guaranteed some sort of benefits for creators, which did not exist before the introduction of this law. “Since almost all music is influenced by the past in at least some way, whether such influence is within norms of creativity and tradition or amounts to plagiarism is connected to an understanding of processes of musical evolution.” (Savage, Patrick E., 2019).

Educationally, music and its teachers need to adapt to the amount of new available information present online and even physically. One might say it needs to evolve to catch up to other subjects such as physics or math.

In the last years there has been an insurgency in the music field, “Technology is ubiquitous. Thus, it is hardly surprising that it has had a profound influence on the art of music in the twentieth century. It has altered how music is transmitted, preserved, heard, performed, and composed” (Kramer, 1988). Firstly seen “with the advent of recordings” (Kramer, 1988), technology has affected our human perception of how we learn, create and transmit music.

Music keeps evolving as long as we keep evolving as a society, it adapts and mutates itself to become accommodate to different cultures and beliefs. It is unthinkable that in the days that go by another Mozart will be born or that in the 1500’s a Michael Jackson would have succeeded. Music evolution and it part during the centuries can be the subject of study, mainly for tis implications in other areas such as copyright and education (Savage, Patrick E., 2019).

2.1.2. Evolution and impact of technology in music

According to (Brown, 2014), “sound recording technologies (the tape recorder, in particular) may have been the biggest technological change affecting music education over the past 100 years”.

Over the last years we have seen a rise of certain digital technologies, such as, computers, mobile devices (phone, iPod) and more importantly the internet which has impacted the music industry and can also impact music teaching practices in such a major way that no one could have predicted the extent of it.

Digital technologies, by being used in the context of music tools, can make jobs easier, tasks more efficient and what was previously impossible possible.” (Brown, 2014). Just

a simple hardware like an audio amplifier can improve a multitude of tasks, it basically amplifies one's already proven skill to an all-new level, while also enhancing one's overall musicianship.

A good example to demonstrate the idea of technology improving already in use skills is the piano and how it is used as a composition tool for musicians and composers. Normally a composer would sit in front of it with a pen and manuscript and write that what would work after testing it on the piano. With technology, the same can be achieved with the usage of a computer with a keyboard on front and a publishing software such as *Finale* or *Sibelius*.

The impact of technology in this area is so enormous that it is hard to successfully measure, without it music cannot reach as many people and even have so many different genres as it has today.

Music education is full of ever-changing technologies, and this is a statement that is believed to continue to be true well into the future. However, it is when integrated into music teaching that it can reach the most important purpose, learning.

“Minds are, in fact, transformed by changing technologies”, (Brown, 2014), therefore, we need to understand the partnerships developed between people and technology. Technologies available to learners are many, from what we call basic today, such as, printed documents and mechanical tools (metronomes), to the more specific, and still not fully incorporated, digital audio devices, musical instrument digital interfaces (MIDI) sequencers, computers, mobile devices, and others.

One of the most affected musical areas has been music production, where not only it has enabled new genres to appear, such as, techno or electronic dance music (EDM). It has allowed the amplification of already existing music instruments, like the electric guitar, the keyboard, among many others that have seen digital versions of itself appear over the last few decades. All of the new instrument versions allow to create or recreate music in a different essence and allow musicians, students and teachers a new way of learning, practicing and creating their ideas, allowing them to be taken out of the mind into the real world to be enjoyed and studied by other people.

In conclusion, thanks to the evolution of technology and its subsequent application to the musical world, we have been able to create more, study more, practice more, and last but not least allow for the usage of the human brain to what it does best, create and think about music from a whole different perspective that was never possible before the introduction of technology into the studied area. However, it is not all roses, we still have

a vast and untapped potential in these technologies that is waiting and ready to be unlocked.

2.2. Instrument Learning

2.2.1. Learning through classes

The teaching of traditional western musical instruments represents a widespread activity in the field of music education. Many learn privately in what is commonly referred to as the studio setting, others study an instrument at school, some progress to higher education institutions (Daniel, 2006).

This area of knowledge counts with limited studies, however there are a few principal findings that have emerged from research, some of them being:

- lessons vary from teacher to teacher, often considerably, and with arguable differences in terms of effectiveness (Siebenaler, 1997);
- teachers control the structure and flow of the lesson environment (Rostvall & West, 2003);
- in some cases, student input in the learning process is minimal (Kennell, 1997);
- several authors (Siebenaler, 1997; Rostvall & West, 2003) argue that greater interaction would potentially lead to better learning outcomes.

In terms of published research, several authors have developed methods to engage in a systematic analysis of music instrument learning, teaching processes and environments, involving a “wide range of sample sizes, forms of data, intervals of sampling, and analytical decisions” (Kennell, 2002).

It is important to point out that the two most common types of classes in this “traditional” method are private classes, typically a one on one between teacher and student, and group classes, where there are a few students normally for every one teacher.

In terms of the one-to one sittings analysis, the students participated minimally in diagnostics and not at all in evaluation or advice. On this type of class it was also noticed that the teacher instruction time was considerably higher, portraying the more focused on teaching dynamic usually found within this type of classes according to (Daniel, 2006).

According to the same research by (Daniel, 2006), in group classes students tend to have a much higher input, leaving less time per class to the teacher instruction dynamic. Lastly student performance also tends to be slightly higher in group classes.

In general, the one-to-one footage features a teacher-dominant mode of transmission, with a relatively limited level of student interaction, exchange, or contribution to the learning environment beyond responding to directed tasks. On the other hand, the small-group context features a more shared environment and greater emphasis on students providing feedback, diagnostics and taking responsibility for learning (Daniel, 2006).

2.2.2. Informal music learning

The definition of self-teaching or self-taught can be said to be the following, “having knowledge or skills acquired by one’s own efforts without formal instruction”, and therefore englobes all the knowledge acquired outside all formal settings such as schools.

Recent advances in online technologies are changing the way we approach instrumental music education. The diversity of online music resources has increased through the availability of digital scores, video tutorials and music applications, creating the need for a cohesive, integrated learning experience. As of the 21st century there are some authors like Purves (2012) and Webster (2007) describing its counter-part, formal learning, as the supplementary tool opposing the common notion. Furthermore, several researchers have confirmed the effectiveness of using learning technologies for teaching of music skills, (Draper, 2008; Eakes, 2008; Hammond and Davis, 2005).

It has been and will continue to be an ever growing method of music learning, with more content each day passed. As of 2015, a basic Youtube search for the terms “learn 3music course” already had 1.5 million videos and the search with terms “learn to play guitar” identified 1.09 million videos. Such simple searches can help to demonstrate the current day relevance of informal music learning.

There exist a series of tasks related to this self-teaching methodologies that are commonly with the aim of one’s prosperity in the area. This tasks can be the search for new material, the seeking of information, demonstrations and feedbacks, the ability to play with other people and the structure of one’s path towards goal.

However, there always exist pending questions to the viability and effectiveness of such methods. There is the question about performance authenticity and pedagogical effectiveness not being regulated on different public websites such as Youtube.com.

Nonetheless, these questions do not affect the desires that led to the rise of informal learning being the main one the desire for a unique and personalized list of their own learning objectives.

In the end, there are several ways to make usage of this method, some of them being, learning through gamification, the community, online courses, post-secondary courses amongst several others.

2.3. Self-taught instrument learning

2.3.1. Self-teaching methodologies

In the world of self-taught music there exist several different methodologies that enable and ease this way of learning the different instruments that exist in the musical panorama.

Firstly we have what Johnson & Hawley (2017) calls “informal learning through identity”. Its main point is platforms that offer opportunities to learn specific instruments and music related to a certain culture or tradition. An example given is “The Online Academy of Irish Music” or OAIM. This platform offers courses for self-taught students, both paid and free, focused on traditional Irish instruments, like the Uilleann or the tin whistle. As Kenny (2013) suggests, “Rather than moving away from tradition, the study of OAIM reveals the importance of fostering the affinity of its users with Ireland and its musical tradition”.

Secondly we have what is called “informal learning through community”. The main point of this method is that the sense of community is found mainly through the literature of informal online music learning, as written by Salavuo (2006). This methodology allow for an enormous number of people, including marginalized ones, to experience a sort of personalized learning through online learning, as described by Brown & Adler (2008). These informal learners might convene in an informal online learning community for furthering musical pursuits and engage in social participation, Salavuo (2006). A good example of this method is the Banjo Hangout, an informal learning community reaching over 51,000 people all with a common goal, to pursuit their leaning of the banjo.

Thirdly, we have “informal learning through curriculum skill set”. This learning methodology focuses on curriculum based learning hubs which, more often than not, offer interactive learning for music students and provide both “traditional” and online music students immediate automated assessments. An example of such hub is Music Theory, which focus on assisting music students with learning the basics.

Last but not least, we have “informal learning through motivation of gamification”. While aesthetic learning does hold value for music appreciation and nominal learning constructs, the understanding of music assists in the pragmatic application of music performance, Johnson & Hawley (2017). A learner might need a procedural knowledge before being able to engage in music. Therefore, whether it is learning instruments, to perform or to listen, motivation is the main underlying footprint for the ways in which students become more involved. An example of how students may be motivated by informal music learning can be demonstrated in the interest of gamification. Combining the learning of musical skill sets and assessment performance through a virtual assessment analysis to enable a scoring of the user in a world ranking. By the linking of learning and community through the gamification process m students have diverse opportunities to motivate themselves to improve their chosen instrument performance. A good example of this method is “Friend Jam”, whose instruments are replicas of actual instruments that therefore allow direct skill transition from the game instruments to the actual real world instrument.

Self-learning however, does have its drawbacks, one of them might just be isolation, as (Koutsoupidou, 2013) writes, “Isolation may become a prohibitive factor for students in order to enjoy their course”.

2.3.2. Learning through apps

Music learning enabled with Web 2.0 is mostly happening in informal settings, not necessarily associated with school music programs, and is often learner initiated, learner created, learner directed, and learner distributed. Along with these Web 2.0 innovations, and the proliferation of personal digital devices, networked music “apps” continue to redefine notions of music making, music sharing, and music learning, (Gouzouasis & Bakan, 2011).

According to Axford (2015), these can be separated in three main categories:

- Creation music;
- Performing music;
- Responding and connecting to music.

When it comes to creation music, it includes notating apps, composing apps, recording apps and anything related to the process of music creation. Performing music apps include singing and training apps, instruments apps, among others. The apps main purpose would be related to the performance of music. At last, responding and connecting apps would include streaming services, music history apps or preparation apps, so everything that would connect music to all human beings as well as transmitting musical knowledge to society.

Various applications for our mobile devices such as Pocket Guitar, TabToolkit, TuneMaster, Chordplay, Chordmaster, Guitar Lab and GrooveMaker have opened up new possibilities for extending music pedagogies into exciting learning settings. Moreover, they are easy to use and learning to use them is as simple as finding app demos on YouTube and playing with the graphical user interface (GUI).

Apps also improve the accessibility of music at a general, improving its distribution to every corner of the world (Spotify, Apple music), they improve the learning ability as most of them are coded mainly for mobile devices (e.g., yousician). Implementations of these new apps are potentially numerous across all music learning and teaching settings. For example, one can implement these apps for chord study away from the guitar, while riding a bus to school. Recording school or community-based rehearsals using a phone or pad device and emailing the resulting digital audio files to choir members to assess their performance could become common practice in the very near future”, (Gouzouasis & Bakan, 2011). All of this technology can very well be used to improve experience and reach the new, more technology dependant generations.

The portability and accessibility of such apps brings up a whole new set of question as well, being the main one “How and what do we create?”. Moreover, the influence that they eventually might held over us is something that should not, in any circumstance, be taken lightly. Finally, there is a need to harness the good elements that these technologies provide us for the betterment of the area they would affect.

2.3.3. Learning through web courses and YouTube

Using the internet to our advantage has always been the main goal. As individuals we know how, teachers must learn how to, so they can improve their own teaching ability. Thanks in part to the evolution of the internet over the past few decades, we have come to find that there are several websites whose main purpose is to teach music or help with the practice of students who have learned it. Everyone is a simple click or browser search away from entering a whole new world of possibilities when it comes to music, (Axford, 2015).

As one might already predict the World Wide Web (WWW) offers a significant amount of material, suitable for music teaching and learning, (Ruismäki & Juvonen, 2009). This tool, that with the exception of electricity has had more impact on music than anything else in the past two centuries, might best be suited to home music education and independent learners, (Salavuo & Myllykoski, 2006). The available websites to the users can, according to Ruismäki and Juvonen (2009), be roughly divided as follows:

- Pages offering information and illustrating materials;
- Pages offering interactive problems and practices;
- Dynamic pages built by web-communities;
- Pages introducing teaching and course syllabi and curriculum.

According to Salavuo (2006), the essential idea of internet learning is to broaden the possibilities, to bring new flexibility and specially to decentralize the learning into communal processes. Music technology and networks can offer new additional value to music learning through representing information differently and joining it into a communal working context. Informal learning has widened and changed the area of learning in several different forms.

Salavuo (2006) also discovered that the websites and networks including a user's own music and discussions tab about music are in a certain way like modern high schools or working people's free-time houses. Musical achievements take place there, they motivate young people in music making and learning, and the pages work as self-organised and requirement-based learning environments at their best. Bakan (2011) tells us "Spending just a few hours on YouTube it becomes self-evident that digital media enables students to learn on their own or in small collaborative groups", which corroborates Salavuo's (2006) statement.

These websites can be used in many diverse ways, for self-learning being the main one so far.

These websites offer infinite possible ways of learning music and its instruments. A rich array of websites and networks for music play and music learning have appeared. YouTube, Facebook, and other participatory websites invite communities of learners and creators to share, play, teach, and learn music. Users of all ages are teaching each other songs on digital video, posting music lessons, and learning to play music from “tab” and other invented notations, (Gouzouasis & Bakan, 2011).

Although some problems related to technology exist when it comes to online training, internet at the same time solves many people’s issues of disability to attend traditional courses. Factors such as distance, travel expenses or work commitment often prevent students from attending a certain course. Online training gives the opportunity to people of different countries and life routines to be educated by following a route that they desire and not what is available-accessible to them in the strict limits of their home place (Koutsoupidou, 2013).

Chapter 3 – Research methodology

The aim of this chapter is to detail the methodology of this work and its objectives and main answer. It is divided between two subchapters, research design and research question and goals.

3.1. Research design

It is evident, from the literary review, that new technologies available in the world of music instrument learning open new possibilities and provide an enormous range of information previously hidden behind payed walls or music schools. These new information technologies are, undoubtedly, changing the way in which we see learning and changing the paradigms which had taken root in the way we learn the discussed topic. According to (Brown, 2014), “technologies may have been the biggest technological change affecting music education over the past 100 years”.

Undeniably, information technologies have become an essential part of anything that a human wants to do and learn. In the case of musical instruments, whether you are learning alone or through classes they give important information and possibilities to train wherever you are with a simple download.

Comparing with previous generations, which did not have that availability of such technologies, new generations can start learning ever younger and cheaper, depending on the choice of technology even free sometimes. This new dynamic allows for an ever growing market for music technologies, which, as a consequence, means more and more advances and investment in the area. This new investment and research allows for more complex technologies that provide the student with something that sometimes it was hard for previous generations, information.

The academy research on the topic of informal music learning and music instrument learning in its generality, the rapid technologic evolution, the appearance of more technologies, the appearance of new methods to learn, took this research to a quantitative approach, developing a study, framed on an anonymous questionnaire. The questionnaire was made and its data collected making use of the google forms platform as it provided an easy alternative to reach a wide range of the population.

The planning behind the data gathering part of this study was based in the literary review. Firstly, basic themes were set up followed by the concepts which will be

approached and correlated. All the data collected for questionnaire responses were treated in the SPSS statistics software.

The questionnaire distribution was mainly done through social media and mouth to mouth, it is also important to point out that its language was Portuguese seeing as it was distributed solely in Portugal. When it comes to what social media it was distributed in, the main two are Facebook, through communities and closed groups, and in Instagram.

All the collected data was the target of validation, identification and removal of non-compliant answers, followed by its statistical treatment.

3.2. Research question and goals

The starting point of this research is based on the main question of this dissertation: **“How important is IT when learning a musical instrument?”**. In order to reach an accurate answer to this important question, several objectives were defined. These objectives derived from the literature review and goals for the dissertation. They also serve as a basis for the structure and the fulfilment of this dissertation. Therefore, the objectives are as follows.

“Verify which are the most used methods are in the learning process”, the intent behind this goal is to successfully determine which methods are predominant when learning a musical instrument.

“Verify what are the most commonly used technological tools are in the learning process”, the intent behind this goal is to determine which ones captivate the users the most are, among the available technologies.

“Determine which are the most used apps are in the learning process”, as it says the aim is to find which apps users prefer to use when learning a musical instrument.

“Associate the used IT with the user satisfaction in the learning process”, the aim is to determine where new technologies stand in the minds of who uses them or have used them.

“Ponder the advantages and disadvantages of the usage of IT in the learning process”, the intent of this goal is to, from an array of possible factors, which act as advantages and which are disadvantages of IT in the learning process of musical instruments.

Chapter 4 – Results presentation and analysis

In this chapter the sample will be described, followed by a presentation of the results obtained from it and concluding with an analysis from said results. It is divided between five subchapters, sample size and profile, questionnaire, data analysis techniques, results presentation and discussion.

4.1. Sample size and profile

In this step of the dissertation, data was collected via an electronic questionnaire, distributed to people of all ages and literary abilities. The sample is constituted by 100 participants, from both genders and with ages comprised between 14 and more than 45 years old, all with a connection to music in its general.

Regarding gender, 44% belonged to the female gender, while 56% belonged to the male gender. When it comes to age, 12% were between 14 and 17 years old, 46% were between 18 and 24 years old, 13% were between 25 and 34 years old, 4% were between 35 and 44 years old and 25% were more than 45 years old.

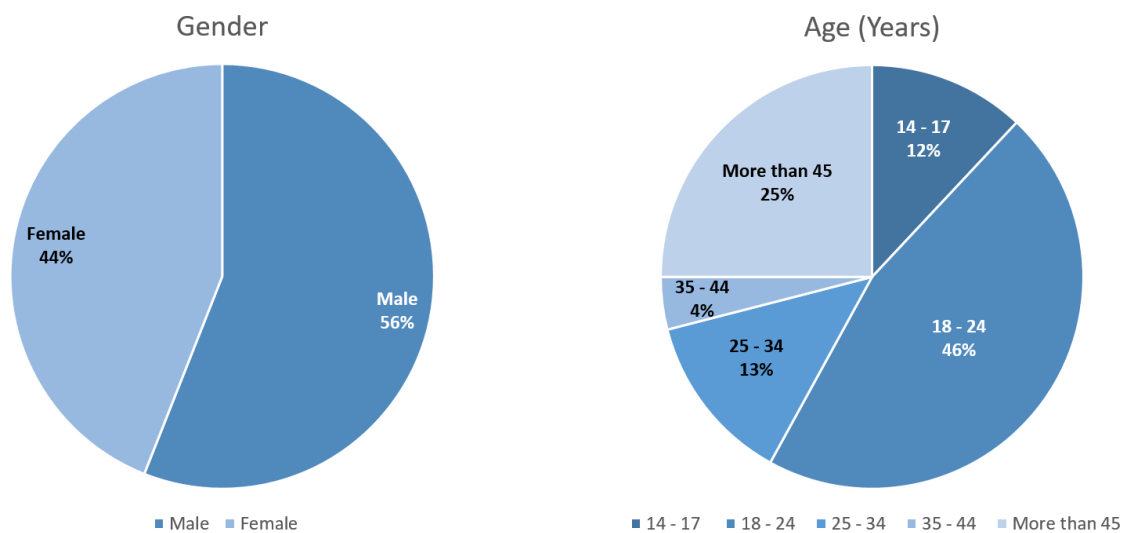


Figure 1 - Gender and Age distributions

Regarding education levels, these being the Portuguese education cycles, 1% had concluded the second cycle, 12% had concluded the third cycle, 19% had concluded the 12th grade, 42% had a bachelor's degree, 23% had a master's degree, the remaining 3% had concluded either a doctorate's degree or a postgraduate study.

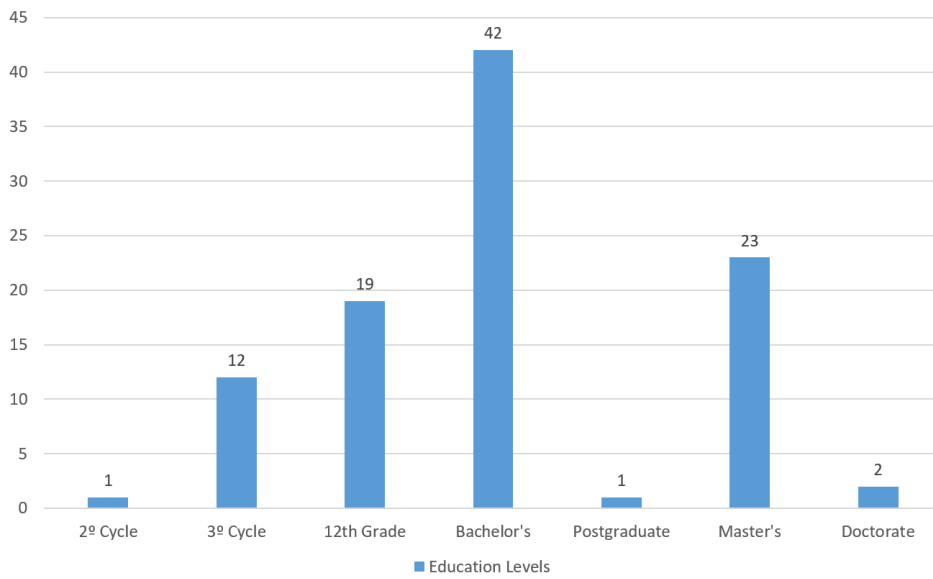


Figure 2 - Education level distribution

Last but not least, regarding job situation, 46% classified themselves as student, 46% classified as employed, 4% classified as unemployed, 2% classified as retired, 1% classified as student worker and another 1% classified as self-employed.

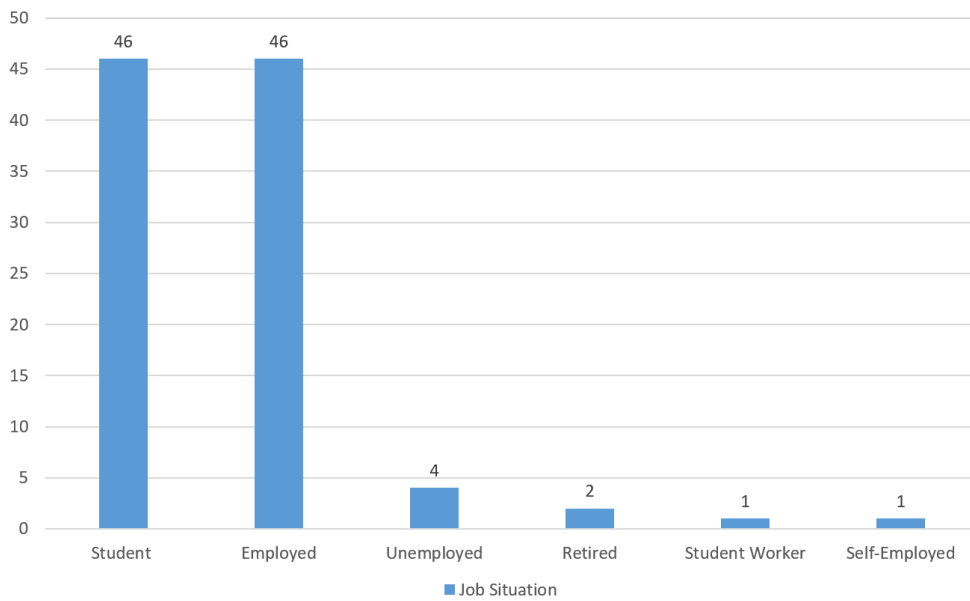


Figure 3 - Job Occupation distribution

4.2. Questionnaire

In order to gain useful information so as to reach the defined goals of this dissertation, a questionnaire was produced using information present in the literary review. Even though the possibility of a low turnout in terms of answers or the existence of non-valid responses associated with this kind of data collection technique is an eventual risk, mainly due to the general public view of this technique as being associated with sales or company market studies (Krosnick, 1999), it was chosen with the basis of the need to obtain quick answers and the minor risk of distortion to said answers. Also, being the main target group of the questionnaire, young people are more used to participate in polls and questionnaires, therefore are also more likely to answer them (Krosnick, 1999). The last reason as to why a questionnaire was made is the current world situation as of the time of the writing of this dissertation, seeing as the pandemic hurt the possibilities of other data collection techniques.

The questionnaire is divided in two parts, the first one being a socio-demographics characterization of the individual. The second part focuses on clarifying how important is information technology in the study of music. In the second part of the questionnaire the questions made were associated with a Likert scale, between 1 and 5 where, for example, the lowest value, coincides with the answer “never” and the highest value, coincides with the answer “very frequently”. The questions performed to the individuals aimed to clarify how important is information technology in their study of music. The research focused on finding their preferred tools and learning methods, the main factors for choosing these tools and how often they use them to practice and learn.

The questionnaire was produced in the “Google Forms” platform. The individuals considered in the study were all of Portuguese residence, so the questions were all asked in their natural language. This allowed the participation of individuals that are not comfortable enough with the English language (Annex A).

4.3. Data Analysis Techniques

Once all needed data has been correctly collected, its treatment and analysis was made using the IBM SPSS Statistics v.27 tool for windows. Firstly, all the collected data was transformed into Likert scale and all the outliers and non-valid responses from the questionnaire were treated. On a second instance, general study between the variables

was developed in order to answer some of the questions of this study. Correlatives studies and principal component analysis (PCA) were also made use of.

4.4. Results

With intent on answering the first big objective, “**Verify which are the most used methods are in the learning process**”, the collected data from questions one and two of the second part of the questionnaire (Annex A) were used. In the first question of part II people indicated which method, from the available options, they would prefer so as to learn a musical instrument.

From the answers, and without sex or age differentiation, the following information was withdrawn. 55% of the participants preferred to learn their instruments through private lessons. 20% that preferred to learn via group lessons. 10% of the participants preferred learning through mobile apps. 8% that preferred to learn through online classes and, finally, 7% preferred to learn by making use of online courses.

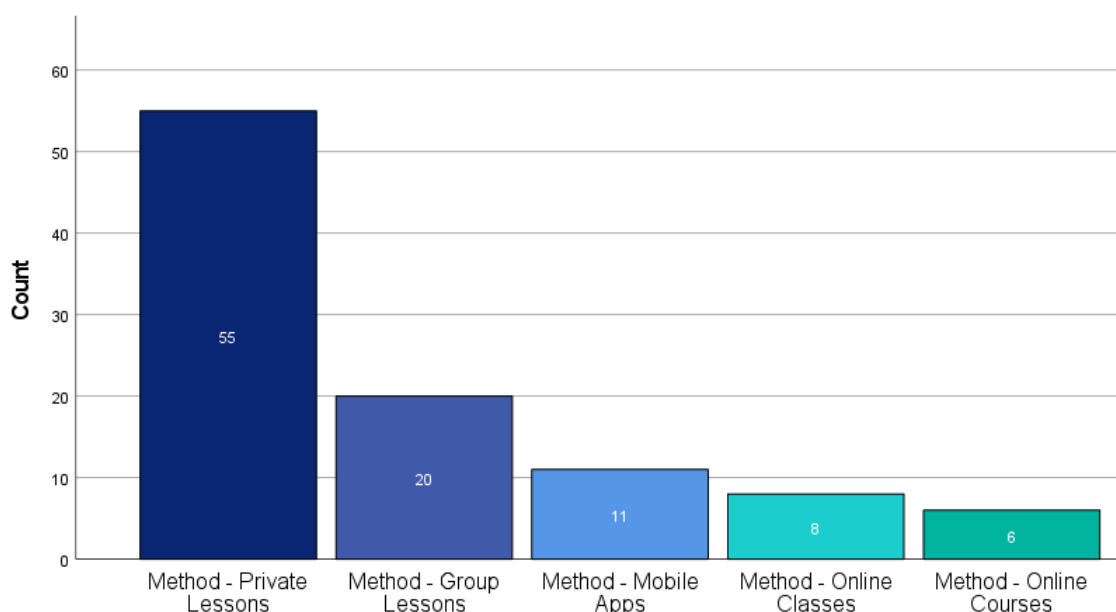


Figure 4 - Preferred Learning Method

For the purpose of more detailed information, a correlative study was produced, correlating the previous information with age.

Table 1 - Age and Preferred Method Correlation (Pearson)

		Age
Preferred Learning Method	Pearson Correlation	-,149
	Sig. (2-tailed)	,139
	N	100

In terms of frequency of usage, using the answers to question two and excluding the population that answered “never” no the usage frequency, there is no real differentiation that can be pointed out between methods, with the exception of online courses and online classed that have a low population that uses them very frequently.

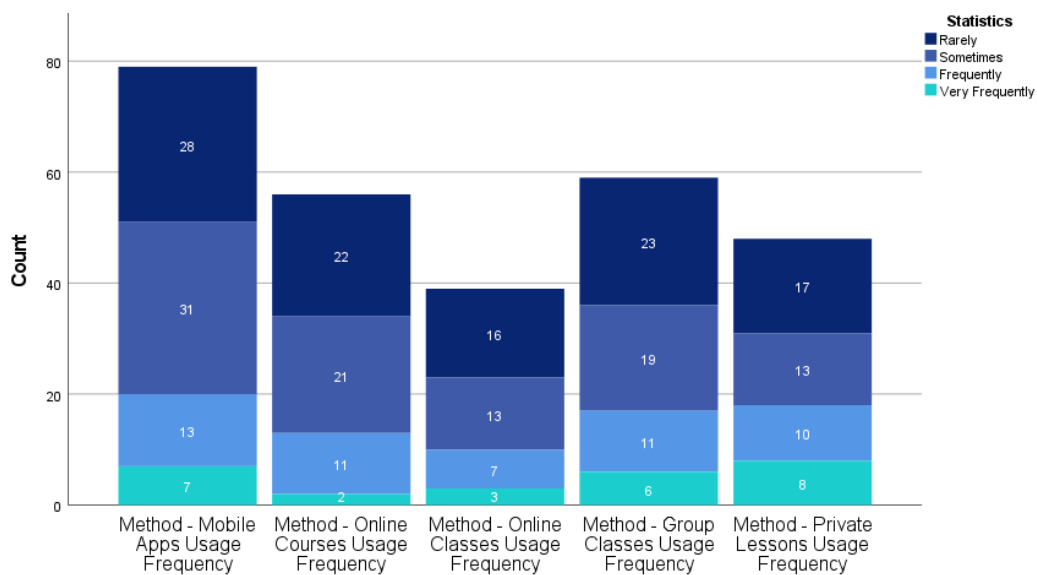


Figura 5 - Usage Frequency by Method

With regards to the second major question of this dissertation, “**Verify what are the most commonly used technological tools in the learning process**”, questions three and four from part II of the questionnaire (Annex A) were made use of.

In the third question people indicated, from a Likert scale (1 – 5), being 1 correspondent to “never” and 5 to “very frequently”, how often they used the different technological tools with intent to learn in a musical context. Similarly to question 2 of the

questionnaire, in this case answers “never” were counted seeing as it would help with the response to the second objective of this dissertation.

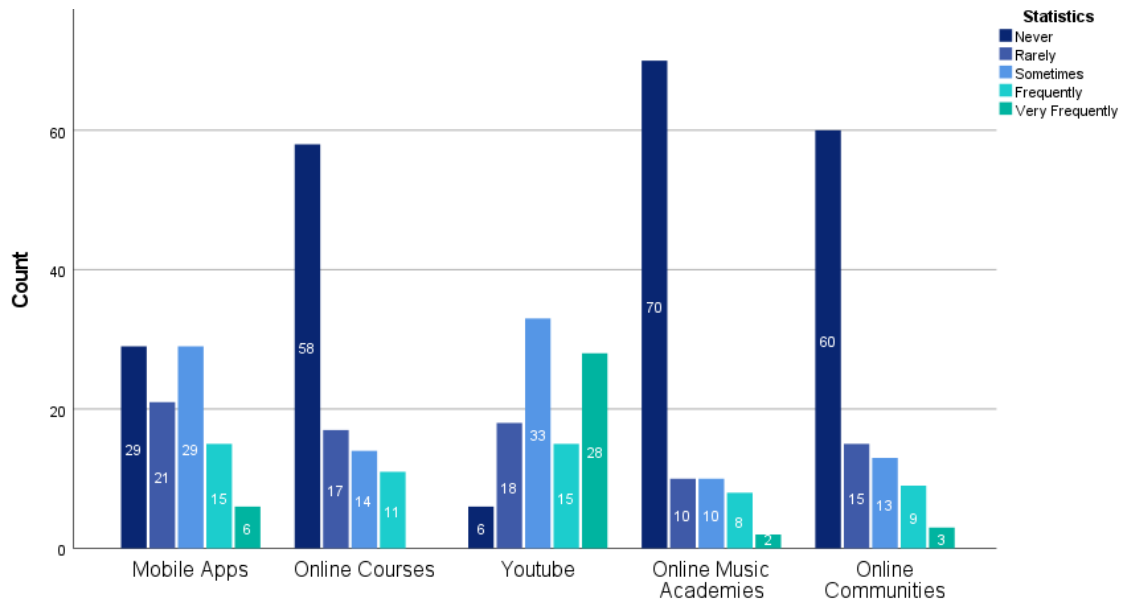


Figure 6 - Usage frequency of IT Tools

It is seen that the online academies, communities and courses are the less used IT tools in the context of music learning. While, in the other hand, mobile apps and YouTube are most commonly used as well as having a more frequent used out of all the people questioned. Finally, online academies have the biggest disparity among the questionnaire population with 70% of people asserting that they not use them at all.

The presented information alone does not give a full picture when it comes to the most used technological method, so, question 4 provides information relating to time spent, per week, using the different tools. For this question the answers “never used” were taken out seeing as they would not provide any sort of relevant information for the study.

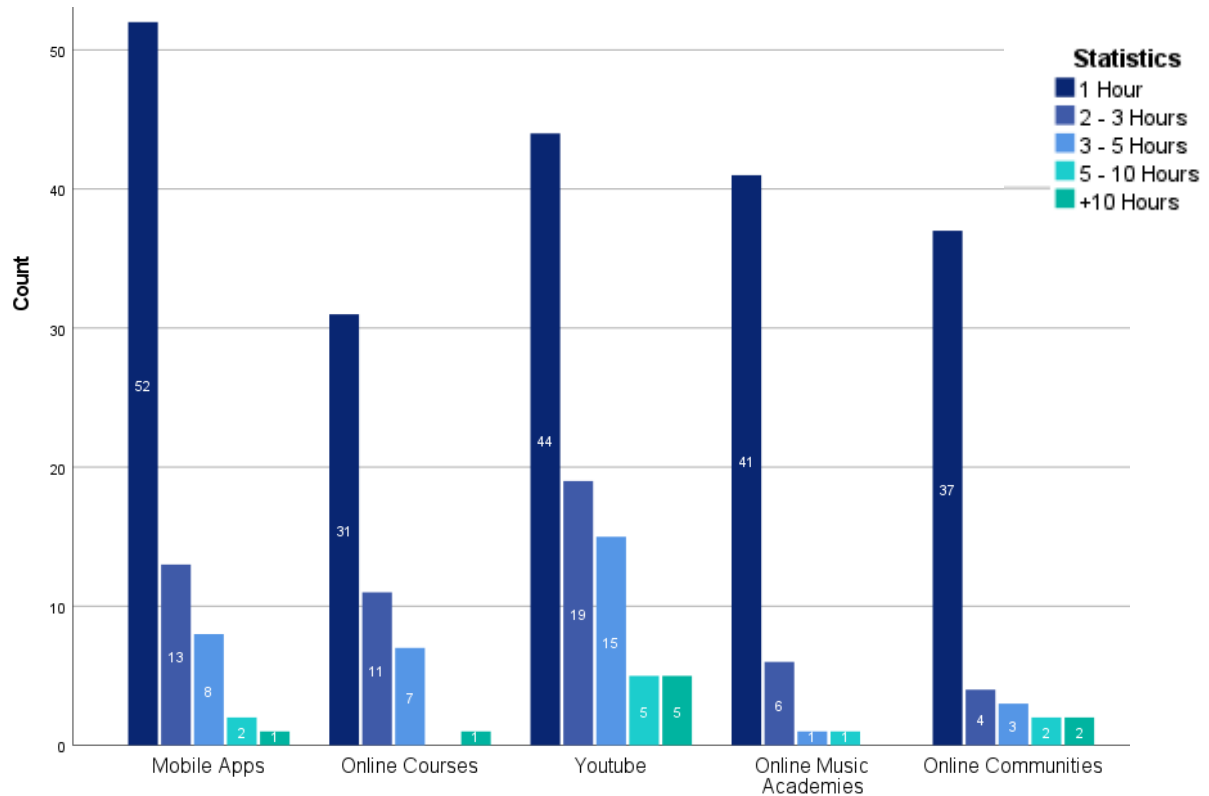


Figure 7 - Time Spent "Per Week" Using IT Tools

From the data analysis of the collected information from question, we can ascertain that mobile apps and YouTube specifically captivate their users a lot more than the other tools, with its users spending a lot more time of their week using them. On the other hand, online courses seems to see the IT tool where its users spend the less time with more than 50% only spending an hour a week using it. Another important information this question provides is the fact that, whilst mobile apps are one of the most used IT tools, 50% of its users usually do not spend more than an hour using them per week.

The third objective of this dissertation aims to “*determine which the most used apps are in the learning process*”. In other to answer this objective, responses from question five of part II of the questionnaire were used. This question comprised of a list of the most used music learning and practicing apps and, from the list, people who answered should check the ones they have used or are using to learn, there was also a possibility of pointing out a new app, in case the app being used was not a part of the presented list.

From the data analysis of question five (Annex A), it is verified that two apps stand out from the rest in terms of use, them being “GarageBand” with a percentage of 27% and “Piano!” with a percentage of 25%. These ones are followed by a distinct second group comprising of five different apps, “Simply Piano” (15%), “Yousician” (14%), “Chord!” (12%), “Real Drum” (10%) and “Justin Guitar” (9%). Another big group are the people who answered and did not use any kind of learning and practicing mobile apps, with a percentage of 22%.

Focusing on the seven most used apps, the following figures (Figure 11) shows their use in function of age.

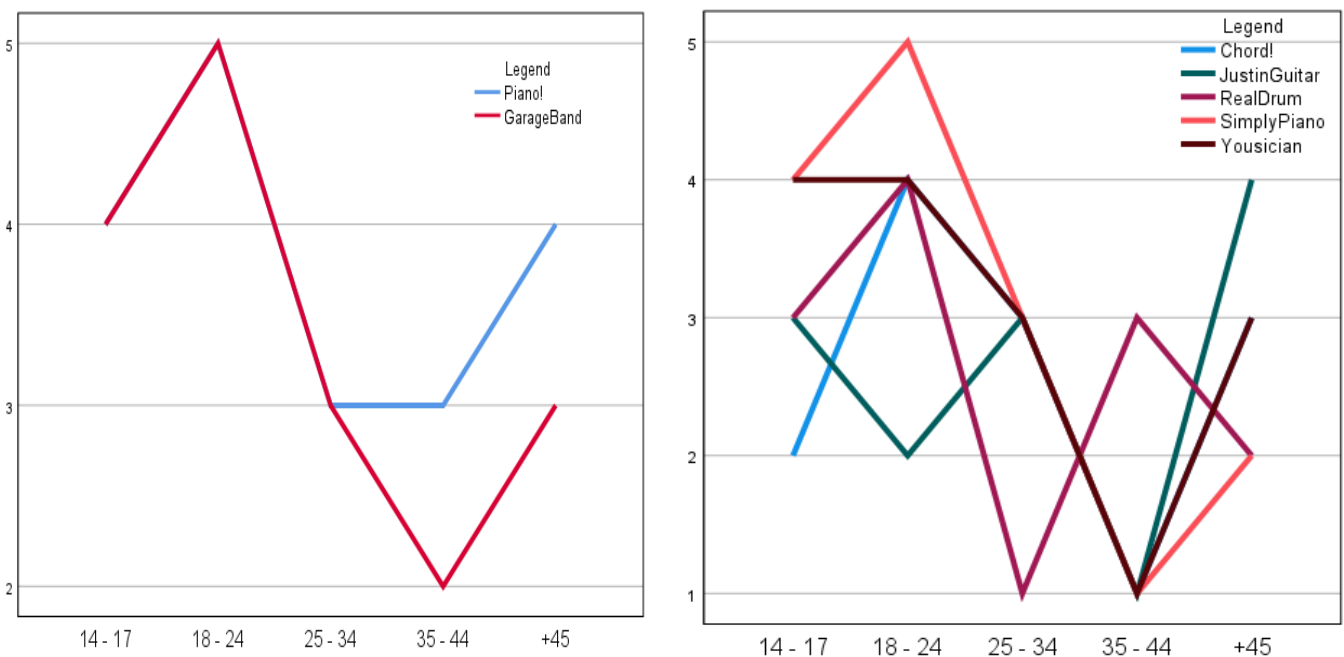


Figure 8 - App Use in Function of Age

From the previous figure, it is observed that apps tend to be used by a younger audience, decaying their use between the ages of 25 to 44 afterwards. However, for the age group of 45+ the apps gain a renewed demand.

Table 2 - Age correlation with the most used apps

		Age
Chord!	Correlation Coefficient	,183
	Sig. (2-tailed)	,069
	N	100
GarageBand	Correlation Coefficient	-,044
	Sig. (2-tailed)	,665
	N	100
Justin Guitar	Correlation Coefficient	-,041
	Sig. (2-tailed)	,682
	N	100
Piano!	Correlation Coefficient	-,38
	Sig. (2-tailed)	,711
	N	100
Real Drum	Correlation Coefficient	-,027
	Sig. (2-tailed)	,787
	N	100
Simply Piano	Correlation Coefficient	-,134
	Sig. (2-tailed)	,183
	N	100
Yousician	Correlation Coefficient	-,207*
	Sig. (2-tailed)	,039
	N	100

*Correlation is significant at the 0,05 level (2-tailed)

Finally, it is observed that, amongst the most used apps, the correlation between age and the amount of people that use the apps is rather weak (Spearman's rho [ρ]), whether it is a positive correlation or a negative one. In terms of negative correlation, the two apps that most stand out are "Yousician" and "Simply Piano", meaning that people tend to stop using these apps as they get older. On the other hand, the only app with a positive correlation between age and its use is "Chord!", meaning this app is more successful than the others when it comes to captivating older audiences and users.

Moving on to the fourth main question of this dissertation, "**associating the used IT with the user satisfaction in the learning process**". For this particular objective, a trio of question come into play, them being question seven, eight and nine of the questionnaire (Annex A).

Beginning with responses to question seven (Annex A), which asked how much, from a *Likert* scale (1 -5) being one "Never" and five "Very Frequently", do technological tools provide useful information about the topic they are learning. The distribution of values presents in the following manner, "Very Frequently" has 14%, "Frequently" has 40%, "Sometimes" has 28%, "Rarely" has 11% and finally "Never" has 7%.

It is perceived that most people do think that IT provide useful information for their learning with a mean answer of 3,43, the skewness of the distribution has a value of -0,591, indicating that the distribution tends to be asymmetric and right-tailed.

Table 3 - Question Seven Descriptives

	N	Mean	Skewness
Do IT provide useful information?	100	3,43	-,591

Continuing to question eight (Annex A), where again from a *Likert* scale (1 – 5) being one "Not Important" and five "Very Important", which asked what the importance of the existence of technological tools is in the context of learning a musical instrument. The distribution of values presents in the following manner, "Very Important" has 26%, "Important" has 36%, "Moderately Important" has 27%, "Little Important" has 7% and finally "Not Important" has 4%.

It is perceived that most people do think that the existence of technological tools is important for their learning with a mean answer being 3,73, the skewness of the distribution has a value of -0,665, indicating that the distribution tends to be asymmetric and right-tailed.

Table 4 - Question Eight Descriptives

	N	Mean	Skewness
Is the existence of technological tools important when learning an instrument?	100	3,73	-,665

Finally, in question nine, people answered the following question: “What is the probability of recommending the use of technological tools for the learning of a musical instrument?”. Answers were given in the form of a *Likert* scale, where one stands for “Not probable” and five stands for “Very Likely”. The distribution of values presents in the following manner, “Very Probable” has 30%, “Probable” has 28%, “Moderate Probability” has 23%, “Small Probability” has 8% and finally “Not Probable” has 11%.

From question nine (Annex A) descriptives, it is perceived that most people would recommend the use of technological tools to learn an instrument with a mean answer being 3,58, the skewness of the distribution has a value of -0,648, indicating that the distribution tends to be asymmetric and right-tailed.

Table 5 - Question Nine Descriptives

	N	Mean	Skewness
Probability of recommending the use of technological tools	100	3,58	-,648

In order to find more detailed data, a correlation analysis was created between responses from all three questions and the demographic information of age and education level.

From the available data it is observed that the correlation regarding age is only slightly relevant for question seven and in the negative with a coefficient of only -0,124 while for questions eight and nine there is practically zero correlation between the two variables.

Regarding the correlation between education levels and the three questions, the correlation coefficients indicate a bigger, although still small, positive correlation between the presented variables, indicating that one's education does in fact affect your mentality regarding the three presented questions. Finally, amongst the three values, the biggest positive correlation is regarding the existence of technological tools (0,214) meant to help with one's learning of an instrument and music in itself.

Table 6 - Age and Education Levels Correlation with Questions 7, 8, 9

		Age	Education Level
Do IT provide useful information? (7)	Correlation Coefficient	-,124	,134
	Sig. (2-tailed)	,220	,183
	N		100
Is the existence of technological tools important when learning an instrument? (8)	Correlation Coefficient	,046	,214*
	Sig. (2-tailed)	,649	,033
	N		100
Probability of recommending the use of technological tools (9)	Correlation Coefficient	-,002	,207*
	Sig. (2-tailed)	,984	,039
	N		100

*Correlation is significant at the 0,05 level (2-tailed)

Lastly, so as to reach a conclusion regarding the last objective, “**Ponder the advantages and disadvantages of the usage of IT in the learning process**”, a principal components analysis (PCA) was created with items belonging to question ten of the questionnaire (Annex A). The reasoning behind the choice of making a PCA can be explained by the usefulness of grouping the different factors into main groups, therefore facilitating not only the visualization of information as giving a clearer view of what this information means.

In the PCA analysis three factors were identified, which correspond to the dimensions existing in the factors behind choosing each learning method presented.

The first factor (36,6% of the total variance explained) clusters items relating to the socialization within the leaning method.

The second factor (20,3% of the total variance explained) clusters items relating to economic reasons.

The third factor (13,5% of the total variance explained) clusters items relating to the amount of information available.

Table 7 - Factorial structure of the existing dimensions of decision factors

	Component		
	Social	Economic	Information
Social Interaction	,831	,076	-,025
Personalization	,779	,014	,302
Location	,652	,477	-,165
Schedule	,596	,582	-,193
Cost	-,070	,852	,281
Facility	,189	,627	,121
Information Availability Online	-,247	,238	,834
Content Variety	,408	,061	,768

For the purpose of data analysis, and to find a clearer view, a correlation matrix was created, correlating the *preferred learning method* from question one and the components which they were grouped in based on the PCA analysis.

Table 8 - Correlation between factors and traditional learning methods

Factor		Private Lessons	Group Lessons
Social	Pearson Correlation	,282**	,170
	Sig. (2-tailed)	,004	,090
Economic	Pearson Correlation	,204*	,181
	Sig. (2-tailed)	,042	,072
Information	Pearson Correlation	-,142	-,123
	Sig. (2-tailed)	,159	,223
**Correlation is significant at the 0,01 level (2-tailed).			
*Correlation is significant at the 0,05 level (2-tailed)			

Table 9 - Correlation between factors and new learning methods

Factor		Mobile Apps	Online Courses	Online Classes
Social	Pearson Correlation	-,072	,068	,220
	Sig. (2-tailed)	,475	,502	,028
Economic	Pearson Correlation	,208*	,166	,138
	Sig. (2-tailed)	,038	,099	,170
Information	Pearson Correlation	,451**	,243*	,126
	Sig. (2-tailed)	,000	,015	,212
**Correlation is significant at the 0,01 level (2-tailed).				
*Correlation is significant at the 0,05 level (2-tailed)				

From the correlation study with the found main three components from PCA, it is clear that the methods which are recognized to be more “lonely” do have a bigger correlation to the economic and information components with the example of the *Pearson* value between information and mobile apps being 0,451.

On the other hand, methods which tend to be more sociable have higher correlations with the social component of the correlative study, as people seem to value more the interactions and might even prefer this methods due to said interactions amongst people.

From the gathered information, an assumption of the two main areas that differentiate the methods can be done, the social aspect and the information aspect, seeing as the economic aspect seems less relevant when taking into account the correlative study results.

4.5. Discussion

From the gathered results, obtained in the results presentation section of this chapter, it is possible to analyze those same results with the intent to try and reach an answer to the presented objectives of this dissertation.

Firstly, from the obtained results regarding the preferred learning method it seems that, despite having a sizeable population, information technologies such as apps, online classes and online courses still are a minority regarding the method most people would like to make use of when learning a musical instrument. More “traditional” methods still are the preferred method of learning. It is possible to identify two major dimensions when discussing preferred learning method of learning, which are the “traditional” methods and the “technological” methods.

Table 10 - Traditional vs Technological Method

Method	N	Count
Traditional	100	75
Technological	100	25

Both dimensions cannot be fully explained by one simple metric. However, when analysing user usage frequency for both dimensions, the results corroborate the base assumption made. Students tend to spend more time learning via the more traditional methods.

Finally, according to the created correlation, it seems that age does not make a difference in the preferred method of learning, contrary to popular belief it seems that the likelihood of a younger person to prefer to make use of technological tools is as high or lower that the same when applied to an older person.

Despite being the less preferred method of learning a musical instrument, it appears that, in the realm of IT tools, the most commonly used ones are the ones that offer the biggest amount of information to its users. From the presented results, it seems that the most used IT tool regarding learning in musical terms is Youtube. Also, complementing the analysis above, the least used one seems to be online courses, probably because most people prefer a physical lesson to an online one.

It is also important to point out that there are three IT tools that have more than half of the answering population stating that they have never used them, them being “Online Courses”, “Online Music Academies” and “Online Communities”. It appears that there is the possibility of IT tools that have a more social aspect tend to be less used and that the student prefers to learn alone than to be pointed to one single direction. This information might imply that a student prefers to use this types of tool to practice rather than to learn the complexities of the instrument.

Lastly, in order to complement the analysis, the indicator of “Time Spent "Per Week" Using IT Tools” corroborates the analysis. With the IT tool which captivates more the users being Youtube. The more social three see its users using them a lot less when compared. The one exception in this rule is “Mobile Apps” that, maybe due to its nature, is used frequently but with the user using it during less time. This may be due to the fact that it is possibly to use them anywhere, conjugated with the availability they have and the fact that they are always within the distance of two clicks through one’s phone.

Overall, despite not being the method of choice for most of the answering population, there still is a great amount of time being dispended per week on the type of tools that compose the “technological” method of learning. The reasons as though why this occurs are most likely availability and ease of use. As an example, it is much easier to go to a

phone and open an app such as “Yousician” than to go to a school and have tradition class.

Regarding “Mobile Apps”, from the presented results we reach an amount of seven different used apps and only 22% of the answering population affirming that they have never used this IT tool before. By the percentage of population saying that they have never used an app it appears that they are in fact common in the day to day of someone learning or practicing a musical instrument.

Within the realm of this seven apps, two stand out as the most used, “GarageBand” and “Piano!”. This is not to assume that they are undoubtedly used a lot more than the others, seeing as “GarageBand” seems to be the most used one amongst the answering population have 27% of them stating that they use it. In fact, all of the seven most used apps have similar percentages of use.

Table 11 - User percentage "Mobile Apps"

App	Chord!	Garage Band	Justin Guitar	Piano !	Real Drum	Simply Piano	Yousician
User Percentage	12%	27%	9%	25%	10%	15%	14%

Another important piece of information to be taken into account is the correlation between these apps and the age of the person. There also seems to be an almost inexistence difference between apps regarding user age difference. It appears that there is no app made with a clear view of the one target only, appearing to be created for everyone.

Moving on and following up, there is no use to having such IT tools available if they do not provide the necessary information and capabilities to actually help the student learn or practice what they want or/and need to.

Starting off with the availability of information, measured through a Likert scale (1 to 5), its results show good indicators. Most people do think that the current information technologies available provide useful information to their needs (i), with a mean of

answer of 3,43. This indicator might imply that information is in fact an important factor seeing as it is one of the main strengths of these methods.

Secondly, most of the answering population indicates that the existence of these tools is important when learning a musical instrument (ii), with a mean of answer of 3,73. It seems that the majority of the answering population agrees that it is at least important to have complementary tools to one’s learning. Overall, and despite not being the preferred method, IT appears to play an important role in this area of learning.

Lastly, as an indicator of the importance and satisfaction of its users, it is the probability of recommending the use of IT tools to another person. Most of the population seems to think that it is worth to recommend the use of these tools to one of his/her peers (iii), with a mean of answer of 3,58. Accentuating the overall satisfaction of the users with their IT tools of choice.

Table 12 - Indicator Means

Indicators	N	Mean
(i)		3,43
(ii)	100	3,73
(iii)		3,58

The created correlation between the three mentioned indicators with age and education levels proved rather informative. Regarding age, it seems that there is little to no correlation between age and the indicators, this might mean that IT has become an integral part of anyone’s life disregarding age as a possible differentiating factor. Education level however, while have low levels of correlation, has shown a more significant correlation between itself and the indicators, this information may mean that people with a higher education level perceive IT tools of learning as more satisfactory and more useful than people with a lower level of education.

All the gathered information can be seen as a consequence of the advantages and disadvantages present in the use of IT tools to learn. From the created PCA analysis we can extract three different components, each grouping a set of factors that make one choose a learning method. These components are as follows: social, economic and information. All these components together account for the majority of the answering population (>70%).

Table 13 - Percentage of population accounted for

Component	Population
Social	36,6%
Economic	20,3%
Information	13,5%
Total	70,4%

Table 14 - Factors grouping

Component	Factors
Social	Social Interaction, Personalization, Location, Schedule
Economic	Cost, Facility
Information	Information Availability Online, Content Variety

Starting off with the social component of the analysis, which groups the “Social Interaction”, “Personalization”, “Location” and “Schedule” factors. As expected, after performing a PCA study with the components correlating with ones preferred method of learning, the social component correlates more with online classes and private and group lessons. The results show that people who prefer the kind of methods also tend to give more importance to the social side of learning. This information joined with the fact that the human being is a social being, gives every appearance of explaining the dominance

of more “traditional” methods, seeing as they usually are the ones with a strong social component to them.

Regarding the second component, economics, it groups the following factors: “Cost” and “Facility”. Overall, this is the less differentiating component, seeing as there is a rather small correlation between it and all the methods. The conclusion appears to be that while important, the economic factors are not one of the major differentiating factors in choosing a method to learn.

Finally, the last component, information, groups the following factors: “Information Availability Online” and “Content Variety”. Following the results, it looks to be a more important deciding factor for the two more digital methods, mobile apps and online courses. The results show that people take this factors more importantly when choosing digital methods to learn an instrument. As expected, seeing as IT tools biggest advantage is the variety and availability of different content, adapting to each and every one as one.

Chapter 5 – Conclusions and future research

This final chapter is about the conclusions obtained from this dissertation, its research limitation, future research proposals and the contributions from this work to society.

5.1 Main conclusions

Recent events in the world have pushed its population to new level of technological adaptation. People were now kind of obliged to make use of it for work, hobbies and everything in-between. The area of music teaching was no different, even people used to and preferring more “traditional” methods of learning had to make use of information technologies to be able to reach their goals and ambitions.

From our findings, regarding all of the learning process, such as time spent, preferred methods, most important factors and how satisfied one is with information tools in this area various conclusion can be obtained. Firstly, information technologies as a tool to learn an instrument are still behind in terms of appeal when compared to what the world is used to. It can be stated that the most used method in learning a musical instrument is the “Private Lesson”. While showing promise that it can one day reach the same level or even surpass those “traditional” methods information technologies still need to find how to do it, how to provide its user in their absolute best form.

Inside the realm of technological tools used in the process of learning, there are a few with a clear cut advantage, either in terms of user base or utilities. YouTube seems without a doubt be the most commonly used information tool in the process of learning. It is also worthy to note that music academies still have a long way to go until they can fulfil their potential and who knows maybe one day replace physical lessons as the way to go when learning an instrument.

Another tool worth noting is apps, growing in popularity disregarding in fact one’s age, they might have the biggest potential out of all the available technological tools, mainly due to the ease of use and availability. From the gathered data it seems that the most used apps in this process are the ones that are in some way affected to the most common instruments, such as the piano, guitar or drums. A fact that might affect this besides a popularity contest is the difficulty in creating something capable of teaching the hardest of musical instruments.

Overall, users seem satisfied by how the various technological tools perform in the area of teaching and practicing, the results do show that it is possible to keep growing and keep implementing features that would make said tools even more appealing to their general audience.

Information technologies in any area have advantages and disadvantages, a clear advantage presents itself in the form of information. With seemingly endless music, practicing programs and easy to grow on the availability of it information plays the main part when one chooses these kind of tools. However, it is still needed to find an effective way to replace the physical contact that gives other methods the edge.

Finally, the results and their analysis that information technologies are in fact important when learning a musical instrument, even if it is only as a complement to a wider program. In this technologies one could say that the sky is the limit, the bigger question is how to reach it, how to create something better and more efficient that can be used by all.

In this work, not only was it possible to verify and research the (six) proposed objectives, it was possible to answer the main question, in the terms that, yes information technologies are important when learning a musical instrument, verifying that there is a good amount of people making use of the in order to learn and practice in order to reach their own personal objectives.

To conclude, there is an importance to information tools in this area. However, we are still far from the ceiling to their ability. If we one day reach such ceiling the ability to play and create music making use of an instrument will be available to learn and practice easily and effectively anywhere where there is internet.

5.2 Research limitations

Without a doubt that one of the limitations in this work was the gathering of information in diversity and more importantly quantity. The fact that the gathered data present an asymmetric distribution regarding age, complicated the statistic process. The comparably small amount of answers to the questionnaire also made the data presented seemingly less reliable.

However, the biggest limitation to this dissertation was the pandemic of the Covid-19. Due to the restriction presented to the world as the result of the spreading of the virus, the original plan of data gathering, making it impossible the realization of focus groups and interviews with relevant people. Mainly damaging the amount of gathered data and therefore the availability of it to the analysis section of this work.

5.3 Future research proposals

As future research proposals in this area of study, first and foremost, a more in-depth study with a bigger population of study, in order to deeply explore the results reached in this dissertation. For example, a bigger population would mean a better differentiation between age groups.

Secondly, the adaptation of IT tools for learning a musical instrument among different countries. For example, how do poorer countries compare with more technological advanced countries in this area of study?

Another interesting possibility is to see how are newer apps adaptation to the increasing requirements of users in regards to information availability and practicality of use.

Finally, an interesting idea as a follow-up work could be to verify how the different instruments fare in terms of them being learnt by use of information technologies. Seeing as not one instrument is the same and more complex instruments may present a harder task when trying to learn them by making use of information technologies.

5.4 Contributions of this work

This investigation contributes to a better perception when it comes to the current state of information technologies in the study of musical instruments, more precisely to general public reception of these technologies, how they feel about them and what they believe are the advantages and disadvantages of these information technologies.

In terms of development of these technologies, this study allows for a better notion of what the user wants to have when using them and what they believe can be improved in order to receive better services.

As a final note, this study allowed the deepening of my knowledge in this area of study as well as to interact with people that have helped in all stages in the process of creating this dissertation.

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Appendix

Appendix A - Questionnaire

Introdução ao Questionário

Este questionário destina-se à recolha de dados para uma dissertação de mestrado cujo objetivo principal é entender o estado atual da aprendizagem de instrumentos musicais através de tecnologias destinadas a esses fins (aplicações, cursos online, etc...).

Todos os dados recolhidos serão tratados de forma anónima e estritamente confidencial, apenas para fim científico.

Esperamos que possa responder da forma mais sincera e espontânea possível. Não existindo repostas corretas ou erradas. Poderá abandonar o questionário a qualquer momento, se assim o desejar.

O tempo necessário para responder a este questionário será de alguns minutos.

Agradecemos, desde já, a sua disponibilidade em colaborar connosco.

Francisco Cardoso (Mestrado em Gestão de Sistemas de Informação | ISCTE-IUL)

Questões

Parte 1

Idade: 5 -13 anos 14 - 17 anos 18 – 24 anos 25 – 34 anos 35 – 44 anos
 +45 anos

Sexo: Feminino Masculino

Ocupação Atual : Estudante Profissão Outra: _____

Escolaridade: 1ºCiclo
 2º Ciclo
 3º Ciclo
 12º Ano
 Licenciatura
 Mestrado
 Doutoramento

Parte 2

1. Qual é o principal método pelo qual preferiria aprender um instrumento musical?

Com um professor em aulas de grupo

- Com um professor em aulas privadas
- Com um professor através de aulas online
- Através de aplicações móveis
- Através de cursos online
- Outro 1
- Outro 2

2. Indique por favor com que frequência utiliza cada um dos seguintes métodos de aprendizagem: (KPI – Métodos mais utilizados)

Métodos de Aprendizagem	Nunca	Raramente	Por vezes	Frequentemente	Muito Frequentemente
Com um professor em aulas de grupo					
Com um professor em aulas privadas					
Com um professor através de aulas online					
Através de aplicações móveis					
Através de cursos online					
Outro 1					
Outro 2					

3. Indique com que frequência usa as seguintes ferramentas tecnológicas: (KPI – Ferramentas mais utilizadas)

Ferramentas Tecnológicas	Nunca	Raramente	Por vezes	Frequentemente	Muito Frequentemente
Aplicações Móveis					
Cursos Online					
Youtube					
Academias de música online					
Comunidade online					
Outra 1					
Outra 2					

4. Quanto tempo, por semana, ocupa a utilizar as seguintes ferramenta tecnológicas de aprendizagem?

Ferramentas Tecnológicas	1 hora	2 – 3 horas	3 – 5 horas	5 – 10 horas	10+ horas
Aplicações Móveis					
Cursos Online					
Youtube					
Academias de música online					
Comunidade online					
Outra 1					
Outra 2					

5. Das seguintes aplicações móveis quais usou no processo de aprendizagem de um instrumento musical?

- | | | |
|--|---------------------------------------|---|
| <input type="checkbox"/> Chord! | <input type="checkbox"/> ScoreSkills | <input type="checkbox"/> Wolfram |
| <input type="checkbox"/> GarageBand | <input type="checkbox"/> Simple Piano | <input type="checkbox"/> Outra 1: _____ |
| <input type="checkbox"/> Justin Guitar | <input type="checkbox"/> SingTrue | <input type="checkbox"/> Outra 2: _____ |

- Piano! Symphony! Outra 3: _____
 Real Drum Yousician Outra 4: _____

6. Com que frequência utiliza as seguintes aplicações móveis de aprendizagem musical?

Aplicações	Nunca	Raramente	Por vezes	Frequentemente	Muito Frequentemente
Chord!					
GrageBand					
JustinGuitar					
Piano!					
Real Drum					
ScoreSkills					
Simply Piano					
SingTrue					
Symphony!					
Yousician					
Wolfram					
Outra 1: _____					
Outra 2: _____					
Outra 3: _____					

7. Até que ponto é que as ferramentas tecnológicas que mais usa fornecem informação útil sobre o tópico que quer aprender?

Nunca	Raramente	Por vezes	Frequentemente	Muito Frequentemente

8. Para si, qual é a importância da existência de ferramentas tecnológicas no contexto de aprendizagem de um instrumento?

Nada Importante	Pouco Importante	Moderadamente Importante	Muito Importante	Muitíssimo Importante

9. Qual a probabilidade de recomendar o uso de ferramentas tecnológicas para a aprendizagem de um instrumento musical?

Nada Provável	Pouco provável	Moderada	Provável	Muito Provável

10. Para as seguintes razões, quais considera importantes aquando a escolha do método que vai utilizar para aprender um instrumento musical?

Razões	Nada	Pouco	Moderadamente	Muito	Muitíssimo
Custo					
Disponibilidade de Informação Online					
Facilidade					
Horários					
Interação Social					
Localização					
Personalização					
Variedade de Conteúdos					
Outra 1: _____					

