M-learning as a Motivational Method in Music Education

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Abstract — **The use of Information and Communication Technology (ICT) in education is a relevant research topic. With the improvement of technology, the use of mobile phones by students is more and more common in the classroom, enabling an appropriate environment for mobile learning (M-learning) through the 'bring your own device' method (BYOD). Mobility is needed when trying to develop digital media tools. This paper analyzes how art and music students in the context of Brazilian high school technical education can be motivated towards supplementary research through these support technologies in order to build and optimize their own Musical Arts knowledge and skills. The primary objective is to guide teachers in using applications as a tool in the teaching and learning process.**

Keywords - Mobile learning; Technology; Music Education; Art; Education.

I. INTRODUCTION

Recent changes in Brazilian educational rules introduced through Law 11.769/2008 [1] require all Brazilian schools to offer music classes. To overcome the challenges of enhancing Musical Arts and music education, Brazilian Federal Institutions, which are a network of federal technical and technological schools distributed throughout the country, are striving to provide their staff and teachers with specific training in music.

Additional challenges within this context include: a need for innovation in educational resources and methods, better communication with the local art and media production sectors and support for students in their needs as a young generation. Examples include M-Learning, Distance Learning (DL), the use of recent technologies, especially in ICT and their application in M-learning and the promotion of autonomous research, as well as the development of didactic tools and resources.

In consideration of contemporary educational opportunities and challenges, the goal of this paper is to provide guidance and motivation to the Federal Institute of Education, Science and Technology of Tocantins - Palmas Campus, so that teachers and students of Musical Arts may expand the application of technological and didactic tools to improve their skills in information and communication resources for a more effective teaching and learning process.

This paper lays out the process of producing a mobile application using current and publicly available technologies to support the teaching and learning process in Musical Arts, including suggestions for integrating student training within technical education, at the Federal Institute of Tocantins.

An important objective is to make the contents of the subject more attractive to the students and to prompt the students to deepen their Musical Arts knowledge. This involves audio and video examples, exploring technological aspects as supportive and motivational tools for learning the content presented in the classroom, including an engaging theoretical basis, creative exercises to help assimilate contents, and complementary research.

To achieve educational results in the exploratory field of new teaching techniques, the challenges of mobility must be solved, since, without mobility, all the efforts employed in the elaboration of digital media will have been in vain. Considering that the method of access to the didactic contents defined was through BYOD, this required compatibility of a great diversity of devices in order to choose the final tool that was made available to students.

In order to address this subject and report on the experience, this paper is divided into the following parts: in Section II, relevant related work on the topics of mobility and education is presented; in Section III, we discuss the research paper proposal, with specifications of materials and methods; in Section IV, the results of the research are presented, through the analysis of the data collected; in Section V, the results and the possibilities of future work are indicated, highlighting the acute use of technologies relative to youth behavior, as well as the application of the App to other subject areas.

II. RELATED WORK

Magalhães [2] addresses the challenges of Internet use in the present educational context, since the current generation was born in a technological era.

Chen [3] points out that even in Asia, where technology is quite advanced, music teachers have three particular concerns about the use of technology in music classes: equipment setup, technical support, and financial burdens.

After analyzing the use of technology in music education, Silva [4] determined that this subject needs to incorporate an entire set of knowledge to achieve better musical practice, involving various applications for proper relevance to Musical Arts as an area of knowledge.

Ali et al. [5] understand that the benefits of mobile devices include ease of access, storage of information, and mobility for academic and social media.

Franchi and Blanco [6] caution that some Brazilian state laws forbid the use of smartphones. The authors suggest, therefore, that teachers and schools must pay attention to the nearly unlimited possibilities for other uses of technology in musical learning processes. A large variety of technologies can be explored for increasing student skills in working with rhythm patterns, timbre, and other sound properties, since technologies are part of the lives of young people and of how they spend much of their time.

Farley et al. [7] indicate that the use of Apps can provide support and increased knowledge to students both in and out of the classroom. The Apps also allow the teachers access to some excellent complementary educational materials through mobile tools.

Camacho [8] reiterates the importance of motivation as fundamental to the teaching and learning process, emphasizing that students need to develop a positive attitude towards the process. The use of technology in the classroom is essential for motivating development, and aids in student assimilation of musical skills.

Wilmer, Sherman and Shein [9] call researchers' attention to the need for studies that also address how the overuse of mobile devices can affect human behavior.

Regarding the contemporaneity and importance of M-learning within the field of Education, Ally and Prieto-Blázquez [10] posit that this is probably the most important current area of educational research and Sung, Chang and Liu [11] argue that the increase of computing portability and the expanded use of mobile networks (wireless communication) have become powerful sources that merit application within traditional classrooms and beyond, particularly as tools of innovation in education.

III. PROPOSAL

The purpose of this work is to encourage the supplementing of Musical Arts disciplines in high schools, and technical schools with ICT and educational technologies. The intent is to provide students and teachers with technological tools in a way that makes those more attractive platforms to support learning and complementary research processes, and to motivate them in applying those support tools for the efficient and effective learning of the contents presented in the classroom.

This proposal seeks a solution to the challenges of innovation and the incorporation of technology within music education. The specific areas of attention include: encompassed improvement in creative interaction between teacher and students; the awakening of students to a more effective participation in and out of class; the expansion of research in applying technology to the practice of Music; enhancement of the quality of contents given in the classroom; increased engagement of students in the teaching and learning process in Music, and corresponding improvement in interest and attitude; improved interdisciplinarity between Music and other areas of knowledge, starting with IT, providing the impetus for

technical education for the productive sector of the local culture and beyond.

This implies a paradigm shift that involves an open environment of collaborative education, since the teacher of the music disciplines will no longer restrict his or her approach to classroom teaching merely to traditional contents, such as paper and pen, magnetic board, computer to multimedia projector, group dynamics, classroom socialization and other teaching methodologies. While those approaches may still be relevant, the teacher and students will also use mobile devices and networks; favoring this kind of environment in the educative context, enables greater interactivity with students, which can motivate them to deepen their musical knowledge, through research, assimilation exercises and artistic creativity. This will help, since "in this fast-changing world, different stakeholders will have to work together to develop new educational models to cater for new generations of learners who will be using mobile technologies that do not exist as yet." [10] (p.145).

This paper results from the need to confront learning problems presented by the current generation of adolescents, herein referred to as the "youth generation", who from the first decade of life have had contact with contemporary technologies and media, as well as the future generation, which is already considered the "virtual generation". It is clear that educational institutions and professionals have the challenge of producing more collaborative content, as well as learning to apply it through virtual environments, which incorporate technology in the classroom and innovate in pedagogical practices.

A. Materials

This research was developed in the graduate course in Telematics. The research group work consisted of joint meetings at the computer science laboratory of the Federal Institute of Tocantins, alternating with virtual meetings each week.

Since the course uses the Problem Based Learning (PBL) methodology, the first part of each meeting was dedicated to solving problems that were presented to the research group by a tutor. This involved rational deliberation, particularly focused on how the various portions of the project would be carried out. The second part of the meetings was devoted to searching for solutions to proposed issues. Virtual meetings made use of cloud-available tools such as BigBlueButton [12], Youtube [13], WhatsApp [14], Gmail [15], Google Family - Classroom [16], Drive [17], Hangouts [18], Docs [19], Sheets [20], Slides [21], Forms [22] - and Overleaf [23].

In order to provide students and teachers with technological tools to support the teaching and learning process, much of the research was devoted to creating an App capable of applying content related to Musical Arts subjects in digital formats available in the cloud and accessible through mobile devices, such as smartphones,

tablets, computers (desktops and notebooks) and other kinds of media with an Internet browser. It was necessary to develop an application compatible with various smartphone platform operational systems, currently used for centralization of the content and ordering in a didactic form defined by the teacher of the discipline.

A variety of functionalities were created in the application to enable its use in or out of the class [6], such as quiz resolution. The digital contents formed by texts, images and videos were presented by the teacher in the classroom and accompanied by students through their own smartphones. On occasion, when students did not have access to their smartphones in class, they were allowed to work with a partner (see Figure 1).

Figure 1.   Students working in pairs to appreciate musical examples.

Quizzes, texts and complimentary videos were attached so that students could use them by themselves outside of class (see Figure 2).

Figure 2.   Student using Ritornello App in Art/Music class.

To develop the application, the following items were used: computers (Itautec desktop and Dell and Samsung notebooks) with Linux and Windows operating systems, with broadband Internet access, a Publisher type subscription of the AppSheet [24] tool to provide the system, Google Drive [17] for digital content storage (PDF, Images, etc.), YouTube [13] for video sharing, Google Sheets [20] to manipulate the content offered in the application, and the following smartphone devices for testing: Asus Zenfone 3, Iphone 5, Iphone 7 and Samsung Galaxy J5 Prime.

To carry out the experiment in the classroom, a raspberry (a hardware computer of the size of a credit card) was available via the G-Redes Group; a Wi-Fi network board and a patch cord ("short" network cable) were used to provide Internet access broadband to students for their own

devices to interact with the content applied by the teacher [6]. This router (see Figure 3), called "Tadeu", had software that was appropriately constructed and integrated to its functioning by another research group linked to Federal Institute, called Network Applied Research Group (NARG). The software gains are: (1) Wi-Fi signal flashing, (2) optimized management of user connections, (3) continuity of roving user connections and (4) stability.

The device and its operating program were created to promote better network signal capture and reception. It is a Wi-Fi router, equipment with two standard 802.11 Wi-Fi interfaces and a 100Mb Ethernet interface, with a system developed by the research group applied to computer networks on the Palmas Campus, which allows seamless and autonomous access to the Internet, using a wireless connection.

Figure 3.   "Tadeu" – Wi-Fi router used in the experiment.

This Wi-Fi mobility is the fundamental basis for everyone to have Internet access through their own device. During the experiment, Internet access was offered through the institute's own data network, as detailed in the previous paragraph; however, access through other means of communication such as LTE, 3G, 4G among others, were enabled. In the version of the application used in the experiment, the content that most required data bandwidth were the videos, which require, as specified by YouTube, a stable connection of at least 1 Mbps so the students could watch the contents without interruptions.

The experiment was repeated 9 times with different classes (see Figure 4) of approximately 25 students. At the end of each class, the students were asked to submit an evaluation questionnaire with questions regarding the teaching tool and how well it met the students' satisfaction for use with the new technology applications.

Figure 4.   Experiment in an IT class technical course – Middle School

To achieve a satisfactory result, it was established that the reliability coefficient for the research would be at least

95%. To reach this level of reliability, it was necessary to define the minimum sample size. Considering that the size of the selected population (students of the Musical Arts discipline) was 160 persons, a total of 115 individuals were asked to answer the questions. The equation to arrive at this result is described in (1), which is called *sample*:

$$a = \left(\frac{\gamma \times 1,96}{\varepsilon}\right)^2 \qquad (1)$$

Where:
a = sample
γ *= standard deviation*
1, 96 = trust level
ε *= estimated error*

The collection of the research was done through a *Google Forms* electronic form at the end of each class through the application itself - *Ritornello* App - which was developed during the research.

After data collection, the results were tabulated for each question, indicating the percentage marked for each alternative and the calculations of standard deviation and the sample error, reaching the variance as in (2):

$$S^2 = \Sigma \left(\frac{Xi - X}{n-1}\right) \qquad (2)$$

Where:
S² = variance
Σ = sum
Xi = value of element
X = average of elements
n = number of elements

At the end, the standard deviation of each item was calculated to obtain the standard deviation as described in (3):

$$S = \sqrt{S^2} \qquad (3)$$

Where:
S = standard deviation
S² = variance

With the tabulated results, a joint study was carried out for debugging the values and understanding the final result, which will be explained in more detail in the subsequent section.

B. Methodology

This research is action research "characterized as a type of research based on empirical research, designed and in close association with the resolution of a collective problem, in which researchers and participants are involved in a cooperative manner." [25] (p. 163 - translated by the authors).

IV. RESULTS

In order to optimize Musical Arts learning through the efficient and effective use of information and communication resources, the conclusion is that it is essential for the education area to keep up with innovations in technology and communication in order to reach students in the contemporary world with its challenges and the new culture that presents itself.

To do this, research is needed for the development and use of new technology applications and implementation of tools that accompany this process of contextualizing education to the new times. Expositive classes, magnetic frames with brushes and group dynamics, for example, can and should be used, but other resources need to be added to the educational dynamics, since educators working in elementary through high school education are dealing with a generation born within the digital age and exposed to it as early as the first decade of life.

The results of this research were obtained through the interpretation of data collected by an evaluation questionnaire developed in Google Forms and applied at the end of each class, when all the students could answer through the App Ritornello itself, after the presentation of the contents scheduled for that class. A total of 115 questionnaires were filled out, with 10 multiple choice questions in each questionnaire (see Table 1), each one with 5 options, with the student selecting only one option for each question.

The questions involved topics such as the coherence between the contents of the Ritornello platform and the teaching plan of the Music Arts discipline, their facilitative and complementary nature, the effectiveness of the evaluations of the contents given in class, through the quizzes in the App, frequency of the App use by the students outside of class and about the user experience, encouragement of academic motivation and degree of educator-student interaction, navigability and the influence of the App on student's artistic creativity.

TABLE I. RITORNELLO EVALUATION QUESTIONS

NR	Questions
1	Is the organization in the *Ritornello* platform coherent with the teaching plan of content in the Musical Arts course?
2	Did *Ritornello* help you learn the Music Arts content better?
3	How much did the contents of *Ritornello* help to complement your knowledge of the discipline?
4	How efficient were the quizzes in evaluating your learning of the contents?
5	How often did you use or think you will use the App outside of the classroom?
6	How satisfied are you with *Ritornello* App in comparison with traditional classes?
7	Did *Ritornello* make you more interested in the Arts / Music discipline?

8	How would you rate the teacher-student interaction with the usage of *Ritornello*?
9	How easy is it to handle the *Ritornello* App?
10	Rate how the App influenced the development of your creativity and artistic expression?

All the questions were answered immediately after use of the App with the intent of showing its effectiveness and to point to improvements for future work.

A. Data Analysis

Question 1 (see Figure 5) dealt with the organization of contents on the App *Ritornello* platform, observing its coherence in relation to the teaching plan of the Music Arts subject.

The results were that 43.5% (50 students) of respondents perceived great coherence between the contents and the platform, 31.3% (36 students) perceived enormous coherence and 25.2% (29 students) saw coherence between the two. The standard deviation of this question is 17.36%, with a sampling error of 3.17%. Thus, 100% of those who answered understand that there is a very positive relationship between the content taught in the course and the application platform, which certainly favored and strengthened the learning of the presented contents.
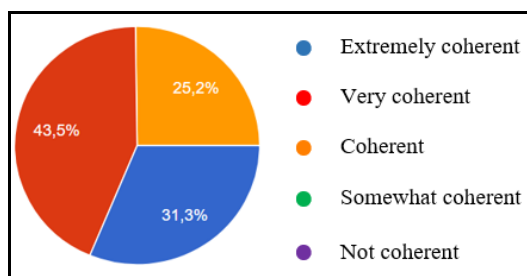

Figure 5. Question 1 results.

Question 2 (see Figure 6) evaluated the effectiveness of *Ritornello*. For this item, 35.7% (41 students) of respondents answered that App *Ritornello* was a good help for learning the content better, 33% (38 students) answered that it helped a lot, 28.7% (33 students) answered that it helped. It was observed that 97.4% (112 students) of the responses were positive, pointing to the application as a tool that facilitates the educational process. Only 2.6% (3 students) evaluated the contribution as being of "little help". The standard deviation of question 2 is 15.45%, with a sampling error of 2.82%.
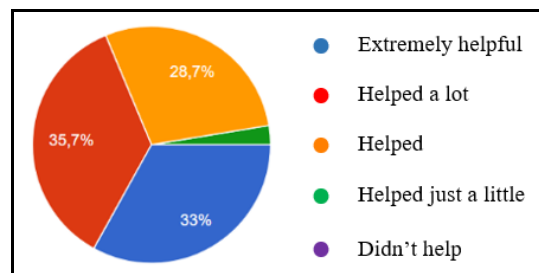

Figure 6. Question 2 results.

In Question 3, the purpose was to test the App's complementary character in relation to the course contents. More than half of the students, 57.4% (66 students), said that the App greatly complements the contents of the music subject ("a lot"), 21.7% (25 students) answered that the App complements extremely the music contents and 20% (23 students) said that it complements moderately ("Reasonably"). In resume, 99.1% (114 students) believed that the App fulfills well the role of complementing the educational process in the classroom. Only 0.9% (1 student) considered the complementary character of the App invalid ("Nothing") (see Figure 7). The standard deviation of this question is 20.82%, with a sampling error of 3.80%.
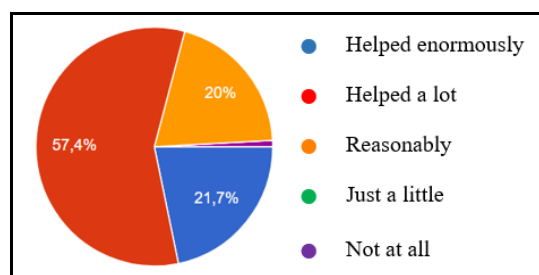

Figure 7. Question 3 results.

Question 4 relates to the quizzes in the App and their effectiveness in evaluating contents. In the answers (see Figure 8), 39.1% (45 students) believe that the quizzes evaluated very well, 31.3% (36 students) said that they evaluated well and 25.2% (29 students) evaluated them as an excellent tool for evaluation. Thus, 95.6% (110 students) acknowledged that the quizzes fulfilled their role of efficiently evaluating the learning of contents per unit, favoring the pedagogical process. In this question, only 4.3% (5 students) concluded that this evaluation was fair. No one considered the quizzes to be inadequate. The standard deviation of this question is 15.27%, with a sampling error of 2.79%.
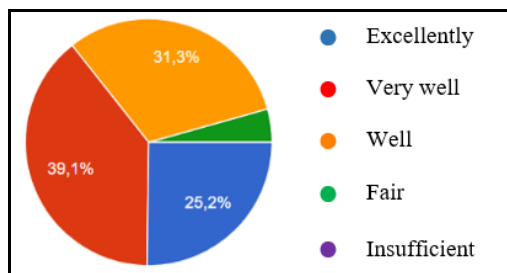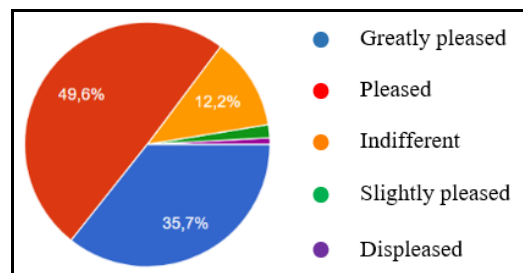
Figure 8.   Question 4 results.

In Question 5, the focus was on how often the students would use the App outside the classroom. The answers (see Figure 9) showed that 48.7% (56 students) reported that they were able to use the App only once a week, 23.5% (27 students) were able to use it twice a week, 13% (15 students) once a day, 9.6% (11 students) never used the App outside of the classroom and 5.2% (6 students) were able to use it 2 or more times a day. With this, 72.2% (83 students) agree that *Ritornello* is a complementary technology tool to be used in or out of class to deepen the contents of the discipline. Despite this, 27.8% (32 students) of those who answered the questionnaire evidenced using the App at other times and places, which may greatly extend the application function in the future. The standard deviation of Question 5 is 15.56%, with a sampling error of 2.84%.
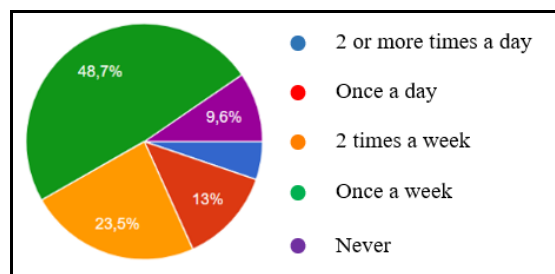

Figure 9.   Question 5 results.

Question 6 evaluated the degree of acceptability of users with the use of the App in relation to traditional classes (see Figure 10), 49.6% (57 students) of the evaluators stated that they are pleased with the App, 35.7% (41 students) said they were greatly pleased, 12.2% (14 students) felt that their use was indifferent in relation to traditional classes, 7% (2 students) reported being slightly pleased and 0.9% (1 student) expressed displeased. In total, 85.3% (98 students) of the students showed acceptance of the use of the App in its relation with traditional classes, evidencing that it presents a positive differential, and is able to potentialize the educational process. The standard deviation of this question is 19.39%, with a sampling error of 3.54%.

Figure 10. Question 6 results.

Question 7 inquired whether the use of the Ritornello App increased the student's interest in the Music Arts discipline (see Figure 11). 46.1% (53 students) of the respondents said yes, they were a little more interested, 32.2% (37 students) answered yes, they were much more interest, 13% (15 students) said that it was indifferent, 7.8% (9 students) pointed that they continued having the same interest and 0.9% (1 student) that their interest has decreased. Only 0.9% (1 student) affirmed that interest in the subject decreased due to its use and 20.8% (24 students) evidenced that they were not affected by the interest in the discipline by using the App. The standard deviation of Question 7 is 16.68%, with a sampling error of 3.04%.
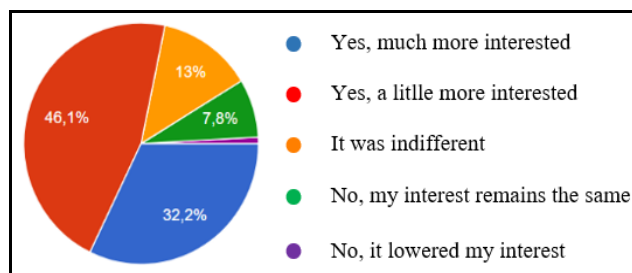

Figure 11. Question 7 results.

Question 8 measured the student-educator interaction. More than half of the respondents, 51.3% (59 students), said that the interaction improved, 34.8% (40 students) that the interaction improved a lot, 13.9% (16 students) answered it was indifferent and 86.1% (99 students) believed that there was an increase of interaction between teacher and students through the use of *Ritornello*. No one said that using the App made it difficult to interact or said that its use eliminated the interaction. The standard deviation for question 8 is 20.18%, with a sampling error of 3.68%. Contrary to what might be commonly thought, the research results point to a positive relationship between actors in the educational process by the use of new technologies in the classroom (see Figure 12).
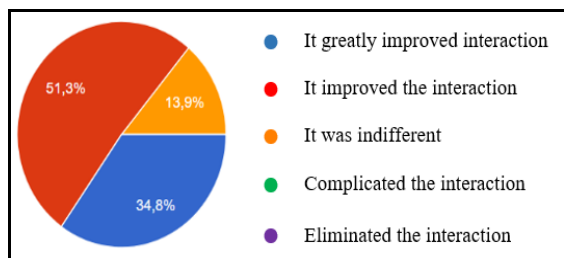
Figure 12. Question 8 results.

Question 9 evaluated the degree of usability of the App. 34.8% (40 students) of respondents said that the use is very easy, 30.4% (36 students) said that is relatively easy and 31.3% (35 students) found it easy. From the respondents 96.5% (111 students) believe that *Ritornello* App is user-friendly. Only 3.5% (4 students) stated that it was difficult to use the application. The standard deviation of this question is 15.02%, with a sampling error of 2.74%. With this response, it is possible to say that *Ritornello* can be widely used in high school and even adapted for use in lower education, to younger people and people who are not accustomed to the use of technologies (see Figure 13).
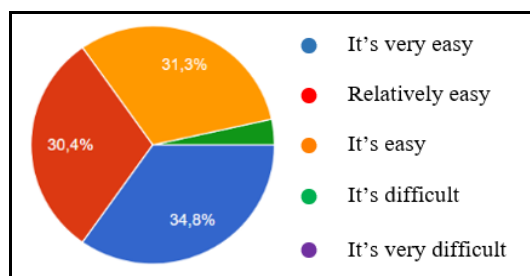

Figure 13. Question 9 results.

Question 10 evaluated the relation between the use of *Ritornello* and the increase of students' creativity ability and its application in students' artistic expression. More than half, 57.4% (66 students), said that the App helped a lot in such development and 20% (23 students) answered that it helped very much, making a total of 77.4% (89 students) holding a positive opinion. Additionally, 18.3% (21 students) were indifferent, 2.6% (3 students) believed that the App did not help with creative subjects and 1.7% (2 students) said that it was of little help in such development. The standard deviation of question 10 is 20.18%, with a sampling error of 3.68% (see Figure 14).
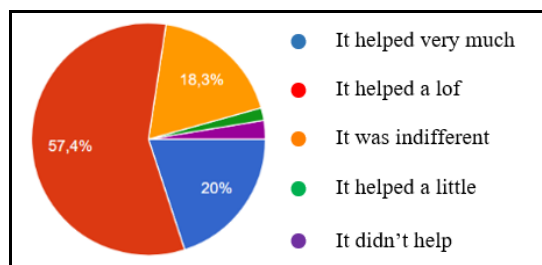

Figure 14. Question 10 results. [red] It was a good help

V. CONCLUSION AND FUTURE WORK

Technology has much to contribute to education, as has been demonstrated by the use of television, multimedia devices and computers for some decades in the classroom. However, the most recent technologies, such as smartphones, also merit application to education, particularly in the context of a hyper-modern world where a large proportion of the population already has access to a portable high-tech device.

Music education, as with other areas of knowledge, needs incentives and adjustments, with properly trained teachers, appropriate methodologies and didactic materials, and updated pedagogical tools that stimulate learning at all levels of the educational system.

The *Ritornello* App was able to supply some of these needs through increased student engagement, which resulted in higher interest in Musical Arts studies, as well as an enhanced teaching and learning process that provided greater satisfaction to the actors involved in it.

Nevertheless, some challenges persist: the lack of broad or consistent access to technology in Brazilian schools; the need for better continuing education training for teachers in the use of technologies; more complete and adequate access to personal computers by students; and of course, the development of more technological educational tools.

Further research will be needed concerning the implementation and monitoring of these tools in the classroom so that they can provide the results appropriate to the environment for which they were created.

Beyond that, it is possible to research how Ritornello could be applied with a broader spectrum of subject and content areas. Based upon the data collection performed in the user experience (UX), the application can undergo further adaptations and improvements. Its relevance could be expanded to various disciplines and contexts of education, capitalizing on its powerful pedagogical potential for dramatic expansion of formal education.

Additional tools could be developed to provide the teacher with further classroom App support; for example, it would be useful to develop a tool which might provide the teacher with graphs to accompany each student's access number, indicating their progress toward learning goals, completion of exercises, and levels of achievement.

As for the development of tools to aid in teaching (M-Learning), it is possible to conclude that the mobility factor should be considered as a premise, given the need to meet the requirements of availability in multiple platforms and the great diversity of devices and means of communications existing at present. The use of specific features of mobile devices such as smartphones and tablets, with devices such as: Camera, Microphone, Accelerometer, Gyroscope, Magnetometer, GPS and others, can be explored in future work to obtain new user experiences.

Another aspect that merits further study is the impact that acute and extensive use of technology may have on student cognition and behavior, especially regarding effects

on relationships, social interactions, and long-term physical and mental health care and relational aspects, since there is a dynamic correlation between Education, Technology and Communication. Given the virtually unlimited potential of these tools, innovative investment and expansion is highly promising, but should be carried out with due caution and appropriate diligence.

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