M-learning as a Motivational Method for Adult Basic and Professional Education

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***Abstract*—It is very important to find ways to improve the teaching methods of adult students enrolled in basic and professional education programs, since these students generally have a deficient education to start with. One way to do so may be using technology to make it easier to access the content to be studied. A mobile application, built according to user-centered design, allows students who own a smartphone to access videos chosen by teachers. In addition, students can answer quizzes as a way to test what they have learned. This mobile application could help these students with the basics of mathematics. After presenting and testing the proposed tool, 55.7% of the students evaluated the tool in a positive way and reported that it improved their understanding of the subject studied.**

Keywords-Mobile Learning; Technology; Education; Adult Education.

I. INTRODUCTION

The National Program of Brazil for the Integration of Basic Education and Vocational Education into the Youth and Adult Education Mode (in Portuguese PROEJA) established by Decree nr. 5.840 [1], of July 13, 2006, has the aim of combining Youth and Adult Education courses with Professional education. PROEJA seeks to teach young people and adults who have not had the opportunity to study in middle and/or high school at the regular age and who also seek to enter a profession. Thus, the youngest age for entering in PROEJA is 18 years old [2].

In general, PROEJA is a modality of teaching involving young people and adults. Thus, teachers must find ways to pass the contents to students in a manner that is dynamic and easy to understand. Especially with this group of students, the creation of a new model of teaching and studying is vital.

Technology enables the use of slides, video-conferencing, collaborative tools, among other technological solutions that can aid the teachers in applying content and improve student's learning experience. Another important point in this learning experience is Mobile learning (M-learning). It is a research field that looks at how mobile applications can collaborate in student learning. M-learning is a very rapidly developing area that has been considered as the future of learning. Mobile devices enhance learning at any moment or place, providing access to learning resources, even outside the school. This flexibility makes it possible for adult learners to minimize their unproductive time, which may enhance their work-education balance [3].

PROEJA students, in general, have had a precarious basic education. This makes the teaching activity even more challenging for the teachers of this program. With math, particularly, this becomes more visible, considering the nature of the competencies acquired. This paper lays out the process for producing a mobile application using available open and free technologies for supporting the teaching and learning process in Mathematics at the Federal Institute of Education, Science and Technology of Tocantins (IFTO). An important objective is to make the contents of the subject attractive and easier for the students.

Therefore, we sought to gather data with the purpose of answering the following research problem: Can the use of technology help teaching math in PROEJA? To do this, we developed an application with a user-centered design so that it was possible to analyze the user experience from the use of this software.

For developing the present study, we used bibliographical and field research, as well as a case study. The bibliographical research was based on scientific publications on user experience and user-centered design. We developed the case study in its entirety through field research at IFTO, campus Palmas, involving the students' profile, their expectations about the tool, general evaluation of the tool and satisfaction survey.

This paper is divided into the following sections: Section 2 presents the work related to the problem; Section 3 describes the proposal presented to solve the problem and Section 4 presents the method used to develop the solution; Section 5 reports the results and presents analysis and discussions, and finally, Section 6 draws conclusions about the project and future work.

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II. Related Work

Silva et al. [4] argued the need to search for new methodologies which value learning in order to discover a form of learning that would be significant for PROEJA students. In the study, it was possible to show that mathematical calculations represent the area of study that is the most challenging to the students of this class. Therefore, the authors concluded that they are dealing with a unique audience that needs to be distinguished from the students of other modalities of teaching in several aspects, such as, limited time in the classroom and difficulties in performing work outside the school.

In [5], the authors discussed the effect of M-learning on mathematics learning. The result of this paper showed that utilization of mobile devices increases the motivation of the students. It means that there is a direct and significant relationship between use of mobile devices and student motivation towards mathematics. The authors concluded that M-learning can help to improve students' academic performance.

Saccol et al. [6] perform a real experience in M-learning for training Information Technology (IT) professionals. For this purpose, they developed and implemented a virtual mobile learning environment called COMTEXT, which was designed to support competence development for workers using PocketPCs. In this study, the learners showed interest and excitement for the innovation characteristic of M-learning, especially because they could become connected and use learning resources in different settings.

Mehdipour et al. [7] state that M-learning is emerging as one of the solutions to the challenges faced by education. The main purpose of their study was to describe the current state of mobile learning, benefits, challenges, and barriers to supporting teaching and learning. They concluded that the use of M-learning in classrooms helped the students working interdependently, in groups, or individually to solve problems, to work on projects, to meet individual needs, and to allow for student voice and choice. With access to so much content anytime and anywhere, there are plenty of opportunities for formal and informal learning, both inside and outside the classroom.

In [8], Mahamad et al. proposed M-learning for mathematics by allowing the extension of technology in the traditional classroom in terms of learning and teaching. A survey has been conducted to investigate the use of mobile devices and to determine if primary school students were ready for mobile learning. The result of the survey shows that mobile phones can be useful in learning mathematics as most of primary school students already use them through many communication activities.

III. Proposal

The teaching of mathematics to students through the use of communication technologies is currently widespread in all social strata and is associated with the vast content of information available on the Internet.

Our proposal is to develop an application for mobile devices (App), such as smartphones and tablets, which makes it easy and practical for students to use specific content and mathematics classes, according to the program content, material available on the Internet and free access. In addition, the application will offer quizzes to help students test their knowledge, correct any mistakes in understanding, and allow the teacher to give tests for assessing student performance.

The assumption was that an easy-to-use application containing contents taught in video-lessons for better understanding and quizzes to test knowledge could help students in learning math. Carvalho et al. [9] make it clear that theories and practice associated with information technology in education have repercussions worldwide, precisely because the technological tools offer academic content, objects, spaces, and instruments capable of renewing situations for interaction, expression, creation, communication and information. All this makes learning very different from what has traditionally been grounded in writing and print media.

A. Operating Structure

In general, the system and the App will use the concept of client-service architecture. In this format, the database resides on a remote server and its information is shared through services that are located on the same server as the application's Web service. This Web service will be exposing the services through a RestFul API (Application Programming Interface), which will be used by both the Web system and the App.

According to [10] RestFul API is an architectural pattern that exposes data and functionality through resources accessed via dedicated URLs over HTTP. REST services feature a request-response pattern, where the HTTP methods Post, Get, Put, and Delete on a given resource are mapped to the respective CRUD operations: Create, Read, Update, and Delete. Service responses contain the representation of the requested resource presented in CSV, JSON, XML, or similar formats. This architecture provides greater data integrity because all users are working with the same information.

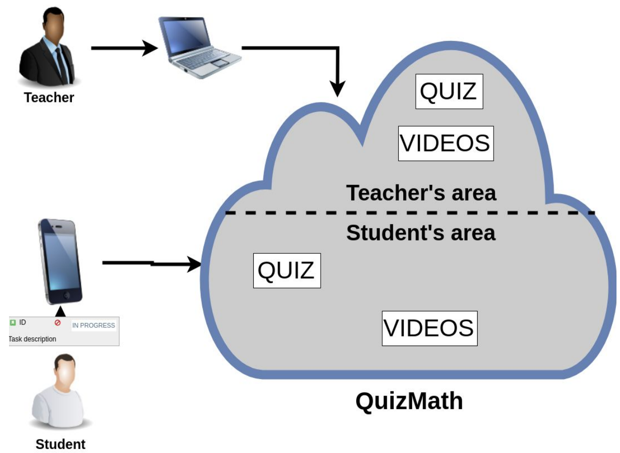

Figure 1. Software Structure.

As can be seen in Figure 1, the system has two aspects: teacher and student. The teacher will be using a Web system, accessed by the browser, and through it will post videos and quizzes for the application. It will also be possible to manage registered students with the application. On the other side will be the students who will use the system through the application that will consume all the information registered by the teachers.

Figure 2. Video Screen.

As can be seen from Figure 2, the video screen lists the video lessons related to the content selected by the student. They will help the student understand the content, thus taking away the doubts that came after the lesson.

We created one server containing all the online services of the application. The database is MongoDB [11] in version 3. We implemented the Web system and Web service using the NodeJS [12] version 8. To develop the application, we used the Ionic Framework [13] of development for mobile applications. The exchange of information from the server to the application is done through JSON files.

IV. Methods

In order to increase the value of this research, we used a case study as a data collection technique. The case study took place a time when it was necessary to survey the current PROEJA scenario, specifically, the mathematics class at IFTO. Based on thisthat could help the students improve in this subject. survey, we develop a tool to solve the problem and check the users' experience with it.

The main aim of this case study was to verify how developing an application helps PROEJA students with learning mathematics as a way to improve their general education, with the purpose of validating the benefit of understanding clearly the basic concepts of mathematics at the IFTO, Campus Palmas, in Palmas, Tocantins, Brazil, in 2018.

First, we used a printed questionnaire about the students' expectations of the proposed tool containing 16 questions; 70 students, 44 women and 26 men, in three PROEJA classes answered the questionnaires. The questions were objective and for most of them we used the Likert scale. This scale ranges from 1 to 5, where 1 represents no interest or total disagreement, level 2 indicates a little interest, level 3 some interest, level 4 interest", and level 5 a lot of interest or totally agree.

After obtaining the results of the expectation questionnaire, we performed an interview with the mathematics teachers of the classes to find out what were the greatest difficulties in teaching of mathematics to this particular group of students and what would be the suggestion of content that could help the students improve in this subject.

Teachers suggested content that was added to the tool's Web system so that it would be consumed by students through the application. Content was written about basic mathematics: operations of addition, subtraction, multiplication, and division; as well as content related to empowerment. After the contents were finalized, we presented the application in the classroom using a digital slide projector.

After presenting the functionalities of the application through the projector, the App was installed on the students' cell phones, to be tested by them. The students watched the videos recorded on the content of basic math operations and

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soon afterwards they answered quizzes about the proposed subject. The students tested the tool for 2 hours.

Next, a satisfaction questionnaire and conversation with students about software improvements were performed. The questionnaire was given to the same 3 groups of students who answered the previous questionnaire and it was used to analyze user experience and validation of the tool. The questionnaire had 18 objective questions, some subjective questions, and most of them used the Likert scale.

In conclusion, the information was obtained in a sensitive manner through two questionnaires of 16 and 18 questions respectively, related to the proposed tool, applied to mathematics students of the IFTO, Campus Palmas. The research was carried out from April 15, 2018 until June 8, 2018, when the students were available.

The research has a 90% degree of reliability of the data presented and analyzed since, for a total of 90 students with a sampling margin of 5% and with a confidence level of 90%, we would need to reach a sample of 68 answers of the students and we obtained a total sample of 70 answers through the two questionnaires. The sample calculation was automated based on a sample calculation tool published by [14].

V. Results and Discussion

In the questionnaire of expectation, the students were asked which types of mobile device they usually take to school, and it was possible to select more than one option.

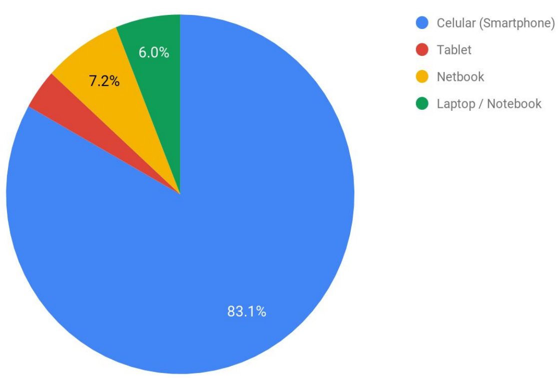

Figure 3. Types of mobile devices usually taken to school.

It can be seen in Figure 3 that all PROEJA students take their mobile devices to school with 83.1% taking their smartphones, followed by 7.2% taking Netbook, 6% taking their laptop and 3.6 % carrying their tablet. It is worth mentioning that developing the mobile application was possible, since the students possessed the devices and took them to the classroom.

Another question from the same questionnaire that students were asked was when they needed to study, but they had to search to find some material if it was more productive to use a smartphone than a computer.

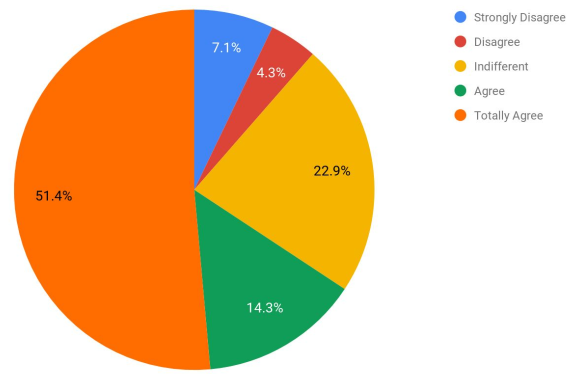

Figure 4. Productivity of the cell phone relative to the computer.

In Figure 4, it can be seen that 51.4% totally agree that a cell phone to study was more productive than using a computer, 14.3% agree with such a statement, 22.9% are indifferent and 4.3% disagree, followed by the 7.1% who disagree completely. It is worth mentioning that adding the agreements gives a percentage of 65.7% of the students. Therefore, it is validated once again that a mathematical study application for the mobile phone would be of great use to students.

Furthermore, some features were presented in which the application would make available in an organized way many videos selected by the teacher as a quiz, through a smart phone, where the student could see the videos and the quiz published by the teacher. In this way, still in the expectation questionnaire, the students were asked if these characteristics made the application a useful tool for the student.

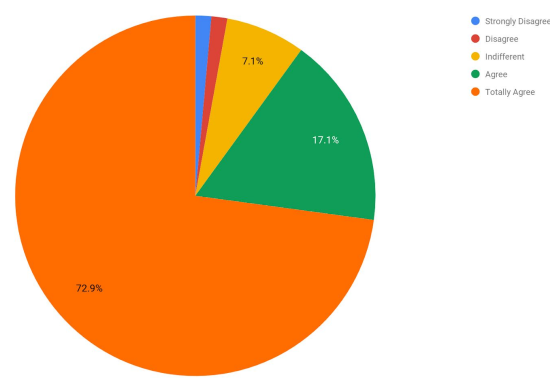

Figure 5. Agreement about application features.

It can be seen from Figure 5 that 72.9% of students agree fully with these characteristics, followed by those who agree, 17.1%, the indifferent add up to 7.1% and those who disagree totaled 1.4%. It is worth noting that adding up only agreement with the first characteristics of the tool accounts for 90% of the students making it possible to create the application again.

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Finally, the last question in the expectation questionnaire asked the students if they were interested in using the application as a tool that would help in their classes. Figure 6 depicts the result of this question.

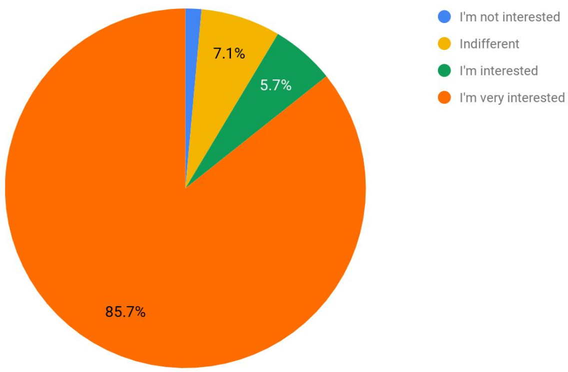

Figure 6. Interest of students regarding the tool.

It can be observed that 85.7% were very interested in the tool as an aid in their classes, 5.7% of them had an interest in the tool, 7.1% are indifferent and only 1.4% of them had no interest in the proposed tool. It is worth mentioning that 93.4% of the students had some interest in using the tool and with this we verified that the students' expectations were high about the proposed application.

After developing the application, presenting to the students and carrying out the tests done by them, we gave a questionnaire of their satisfaction with the proposed application. Students were asked how satisfied they were with the proposed application. Figure 7 depicts the results of this question.

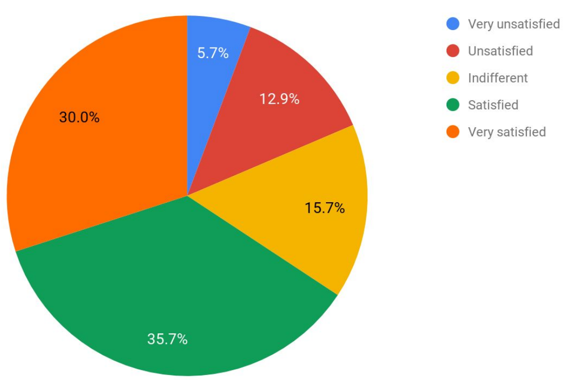

Figure 7. User satisfaction.

It can be observed that 30% of the students were very satisfied with the tool, followed by 35.7% of the students who were satisfied, 15.7% were indifferent, 12.9% were unsatisfied and 5.7% very dissatisfied. The satisfaction was obtained from 65.7% s of the students, and if one subtracts those who were indifferent, only about 18.6% of the students were not satisfied with the tool. We found, therefore, that the overall level of student satisfaction was high.

In order for us to verify whether the application met the expectation created by the students, we asked them in a question in the questionnaire using the Likert scale again. The result can be seen in Figure 8.

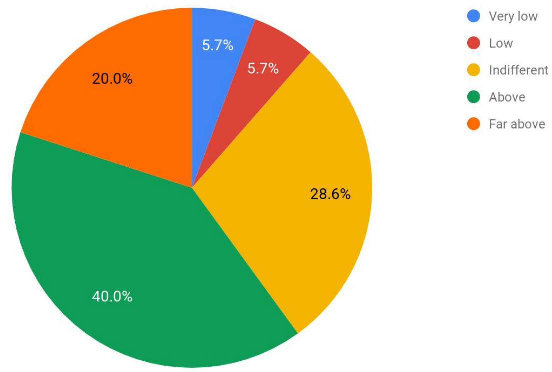

Figure 8. Approval of user expectations.

It can be seen that 20% of the respondents stated that the application was far above their expectations, 40% stated that the application was above their expectations, about 28.6% declared themselves indifferent, 5.7% said the tool was below expectations and another 5.7% said it was far below expectations. It is worth noting that 60% of the respondents stated that the application exceeded their expectations and only 11.4% stated that the application did not meet their expectations. We therefore found that the application has achieved a good user experience by evaluating the application before with the expectation search, during the tests of the users and at the end with the satisfaction survey, the majority of users declared themselves satisfied with the proposed tool.

Finally, to confirm whether the tool would help students in mathematics teaching, students were asked if the use of the tool allowed them to have contact with the same subject, but in a clearer way.

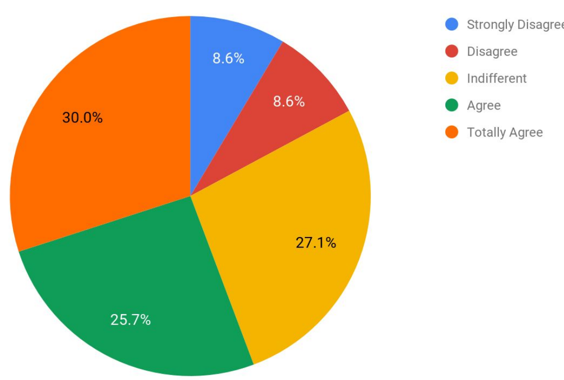

Figure 9. Application learning aid.

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According to Figure 9, it can be seen that 30% of the students totally agreed that the application helped them to more clearly understand a math content, 25.7% agreed, 27.1% were indifferent, 8.6% disagreed and another 8.6% disagreed completely. It is worth noting that a total of 55.7% of students agreed that the application made learning the content clearer and easier to understand and only 17.2% were not satisfied. We found that the application brought some benefits for students, such as, learning the content more clearly and easily.

VI. Conclusion and Future Work

Developing the present study allowed an analysis of the needs of PROEJA students and their difficulties in learning mathematics, while allowing us to create an application on demand that could be a tool to aid students in learning. The application is not replacing the teaching models already used, but will be an aid for the class in reinforcing the content studied.

Overall, teachers have shown an interest in working on the topic in the classroom and are looking for ways to be up-to-date, but they still have some difficulties, such as students' lack of knowledge about basic mathematics. Teachers were eager to feed information to the toll by posting a video for the students and questions for practicing math concepts.

Students have also shown considerable interest in the subject and will look through the application to learn about the content. Based on the research data, it can be concluded that 55.7% of the students evaluated the tool positively and reported that it improved their understanding of the subject studied. This way, the application will be a great tool to help students learn, because we concluded that the application had a positive user experience and helped them to learn the content.

Given the importance of the theme, it is necessary to carry out the suggestions and functionalities suggested by the students to make the application a better tool and provide a better user experience, besides conducting research with the teachers about the Web tool that will be used by them, in order to bring new contents to the students.

In this sense, the application of teaching mathematics in PROEJA will allow teachers to mediate the teaching/learning process in a more enriching way, motivating the student to have more desire to learn and helping make learning really meaningful.

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