

## Development of Mobile App for College Math: MathTech

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**Abstract**— The development of a mobile Application (Math Tech) is presented, base on the Scrum methodology, which shows an innovative way a set of mathematical formulas and examples of their use for the subjects of mathematics for pre-university courses, linear algebra, differential and integral calculus and operation research of the curricula by Instituto Tecnológico Superior de Comalcalco (ITSC). The App will be a great support in order to improve their abilities in Math. The use of Scrum, given its characteristics, allowed for the programming of the App in a clear, agile and simple way. Additionally, a variety of creative visuals elements have been included that give to the app a higher quality.

**Keywords**— Teaching mathematics, mobile App, m-learning, Scrum methodology, educational software.

### I. INTRODUCTION

In the field of mathematics education research, it is well known that the habitual teaching of mathematics, is based on the transmission of knowledge with a very strong emphasis on the development of algebraic skill and, intellectual discernment for understanding ideas, notions and concepts is neglected [1]. Some Works [2], [3] point out that traditional, mechanistic, decontextualized and technical teaching hinders the understanding of mathematics concepts and their links with other sciences. This problem is shared with Mexico, where most universities have a high failure rate. In particular, during January-April 2019, the ITSC had a 47% failure rate in subjects related to the study of mathematics, according to the records of school services.

Although there are various strategies to improve the teaching of mathematics, B-learning is a methodology that combine face-to-face instruction with online learning and has given good results since it was officially investigated as an educational model. An advantage of this approach is that it increases the flexibility and individualization of students' learning experiences, and allows teachers to extend the time they spend as learning facilitator. Brioli [4], points out that combined learning classes (B-learning) produce statistically better results than if they are only face-to-face classes. It is also important to note that our students are from the generation of digital games and social networks. It cannot be ignored that they are no longer the same for which the educational system was designed a few decades ago, to day new educational models are required where students learn to develop their cognitive skills making use of various computational tools [5] that are at our disposal.

Heide and Stilborne [6], points out “the technological revolution has produced a generation of students who grew

up with interactive and multidimensional media”. A generation whose expectations and worldviews are different from those that preceded it. In this context, it is convenient to consider the integration of digital media and mobile devices (tablets, phablets or smartphone) which allows students to set personal goals, manage educational content and communicative with others in the appropriate context [7]. Teachers will have at their disposal a pedagogical tool with an extra value for the teaching of mathematics since technological innovation is sometimes necessary to awaken the interest of young people. Thanks to this support mobile application, there will be interactivity between teacher-technology-student benefiting each field addressed. Our application has an innovative and attractive design that stimulates an active participation of the student in the construction of knowledge. The use of mobile devices that are widely available provides the opportunity for students and teachers to change the teaching / learning process. According to Castells [8], ICTs represent a great technological change that has undoubtedly affected society, the economy and culture. It has resulted in the rethinking of educational models, new educational modalities appear, and the use of the internet and ICTs is incorporated into education. Leveraging mobile devices for teaching and learning is required. However, in many countries, teachers and students do not use mobile devices for teaching and learning purposes. According to the Commission of the European Union (EU), which is an initiative to open up education [9], between 50% and 80% of students in EU countries never use digital textbooks, software of exercises, podcast, simulations or learning games. Currently, it can be found that technology tends to be present in every corner of the world, thanks to the fact that it has become more economical and easily accessible. Being accessible to all and having minimum requirements for its implementation make it a great means of

dissemination, campaigns have even been carried out where education aims to be encouraged and taken to all corners of the world. Therefore, it is necessary to study the different variables in the implementation of any project based on the educational environment, finding opportunities for improvement, topics, methodologies and scope of the solution to be implemented in such a way that this is not just a tool that does not really comply with the desired purpose.

Learning has resulted in an evolution in educational models that seek to adapt to the accelerated pace of technological advance. Mobile learning, seeks to respond to the educational demand of the 21st century by providing advantages such as: greater flexibility to learn at the time and place that is decided, personalize learning experiences, achieve meaningful learning through the design of instructional environments, development or strengthening of their professional skills and greater learning effectiveness by promoting active attention [10]. Mobile applications have greatly increased the improvement of many tasks that humans perform, enabling their efficiency and productivity [11].

## II. RELATED WORK

In the case of this project, the use of this type of mobile tools becomes very relevant, since it can be applied as educational support. In such a way that they acquire knowledge through learning that is attractive for students that facilitates them the use of the knowledge base as support in solving problems, applied to the engineering they are studying. In particular, in the subjects that involve mathematics for the study programs offered at the ITSC, it is common to have didactic material such as forms, which are a collection of classified formulas, which the student uses as problem solving guide. These forms are generally handmade and are sometimes incomplete or susceptible to human error. In this sense, such formula guides, it is suggested, be as clear and attractive as possible, in addition to being portable and according to the new needs of the cognitive process. Therefore, a mobile app has been developed with an attractive, simple but robust graphical interface that contains a collection of mathematical formulas that serve as didactic support material that is part of the ITSC, contributing to educational innovation in the academic area. This application will contribute to the implementation of a mixed model for the teaching of mathematics through a digital glossary of formulas classified according to the subjects of linear algebra, differential calculus, integral calculus, operation research and pre-university topics.

On the other hand, Scrum is an agile development methodology [12] based on the creation of short cycles for development, which are commonly called iterations (sprints), which comprise four phases that define the software development cycle such as: concept, speculation, exploration and closure. The development of this mobile application plans to extend the traditional learning

environment to a collaborative virtual environment that will keep students connected to the App to learn mathematics by exploring a digital library of formulas that support the solution of mathematical problems. The mobile application will serve as support for the resolution of university mathematics problems for the common core subjects of all ITSC programs. In addition, as a fundamental part of the App, various topics related to the subject of pre-university mathematics are included, which will facilitate students to remember skills acquired in the preparatory and that are necessary to learn, understand and master the new knowledge that is required to have a good academic development at the higher level. The App was designed taking as reference the academic conditions in the area of mathematics, with which high school students get into the Instituto Tecnológico Superior de Comalcalco. In addition, the topics covered in the App are defined in the study plans of the Tecnológico Nacional de México (TecNM) as well as in the mathematics syllabus for the introductory course, however, it can be used as a support in any other university that includes subjects from the common core of the engineering area.

## III. METHODOLOGY

The present work has a qualitative logic research approach and a descriptive study. The agile Scrum methodology was used for the analysis, design and implementation of the mobile application of mathematics, which includes topics from Linear Algebra, Differential Calculus and Operation Research for the engineering careers in the ITSC. Lists of requirements for the app, activity schedule and user stories were created, making the necessary revisions for their approval [13]. Based on the above, task lists, estimates of them, and preparation of sprint pending lists were prepared, obtaining as a result the analysis, design and development of the mathematics mobile application. The Dart programming language and the Flutter mobile application development framework were used and, in the design phase and, Back-end development, the JavaScript programming language and the multiplatform runtime environment framework were used for the Node JS server layer, since most mobile devices are compatible with them. The App will be free to download and can be used by any student or teacher in the area of mathematics who so wishes. The App is available in Play Store for Android system.

## IV. RESULTS AND DISCUSSION

The design and development of the mobile application is described, applied to an academic environment. The App works on a web server and with a relational database management system to store and search information according to the user's preferences, such as subject, topic, formula or example of use. It contains four main modules (Figure 1): main menu module, subject module, precursors module and the configuration or user preferences module.

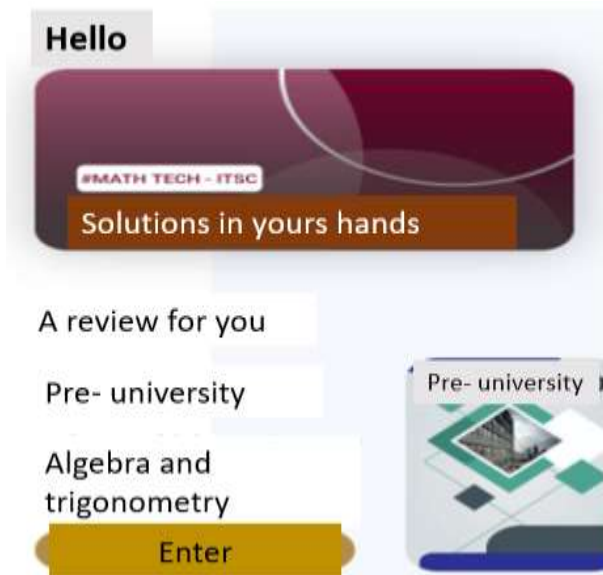


Figure 1. App's wireframe

In the Main Menu module (Figure 2), access to the multiple functions offered by the App was developed such as navigation in the collection of subjects, topics and formulas, access to the application settings and the return button. In this module, a search sub-module was implemented in the same way that allows the user to find a specific formula of all the subjects that the App contains. These navigations used various animation effects that give the App originality and quality.

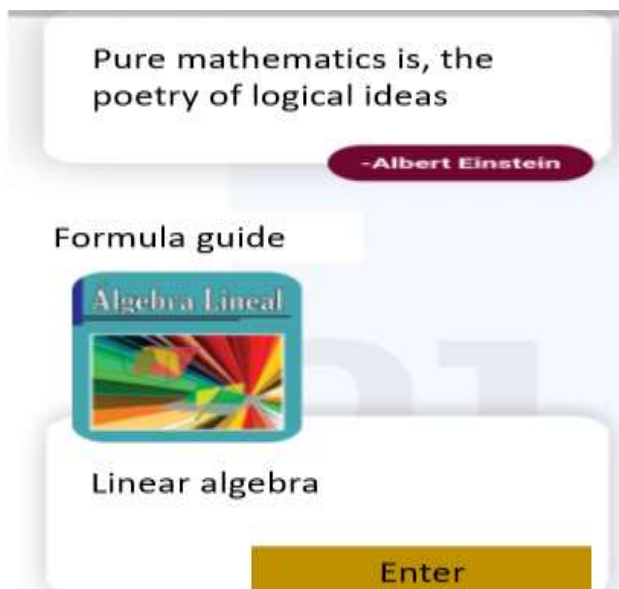


Figure 2. App's Main Menu.

The second module is about the subjects. Through the main menu, you can select a subject/topic from the reel of subjects. Once selected, the overall goal and index of your topics will be displayed (Figure 3). When selecting a specific topic, the widgets with the formulas corresponding to that topic and an example of how to use the formula will be displayed in a horizontal navigation. This module also has access to the precursor reel, which will be described later.

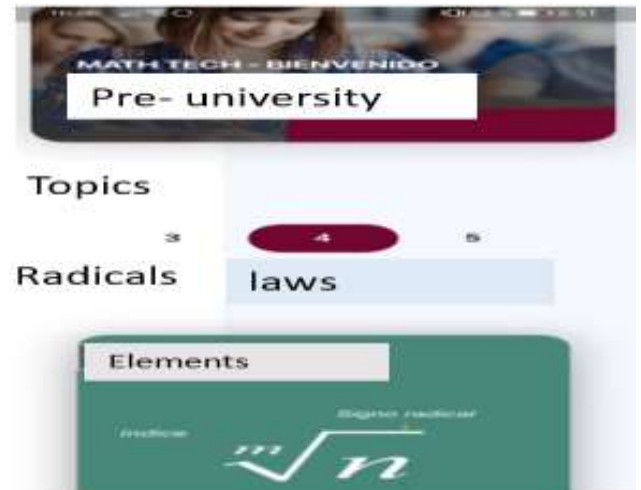


Figure 3. Reel of subjects

The third module is about precursors, it has a navigation menu and widgets to view the main data of the precursor, which contains a summarized bibliography of each of the important characters classified by subject. Within the bibliography, the user can access a link that guides them to a website where they will find more information about that character. The last module of the App is the configuration or user preferences. This module contains four main functions. Dark mode is the first function that allows changing the design style of the application, which means allowing the user to change the light colours of the App to dark colours and vice.

Offline mode is the second function that stores cards of the subjects that the user selects on the cell phone, in such a way that it allows them to access even without the use of mobile data or Internet networks. The third function is a Contact us: option and consultation of the basic information of the application.

With the use of the App in the subject of Mathematics for the preparatory, users will be able to solve exercises and problems in which the rules of signs, problems of addition, subtraction, multiplication and division of fractions are applied, as well as the laws of exponents and, radicals in operations of addition, subtraction, division, multiplication and power. Added to operations of addition, subtraction, multiplication and division of polynomials. Regarding the subject of Linear Algebra, the user will be able to use complex numbers, their representations and the operations between them [14]. Solve exercises on addition operations, and multiplication and techniques for division with complex numbers, as well as transformations in their different forms. You will also be able to solve matrix addition exercises, multiplication by a scalar and matrix multiplication, identifying when they can be carried out and identifying the order of the resulting matrix [15]. On the other hand, in the Operation Research, they will have support to solve exercises on waiting line systems, deterministic problems where the optimal batch methodology is applied with and without depletion [16]. In relation to the Differential Calculus, students will be able

to apply the notation of intervals, solve first-degree inequalities with an unknown variable, define limits of functions to analytically determine the continuity of a function, as well as use the definition of derivative for analysis of functions and the calculus of derivatives. For Integral Calculus, the user will identify the most appropriate integration method to solve an indefinite integral, calculate definite integrals, solve integrals that cannot be solved directly, trigonometric, algebraic, exponential, logarithmic, etc. Currently, the free Apps that exist were designed for students of preschool, primary, and secondary level and cover some high school subjects; but designed exclusively for a higher level, no App with characteristics similar to our proposal was found. In addition, those that exist cover only some topics in a general way and not all topics are found in the TecNM study programs. With MathTech, the current need for a digital form for the mathematics subjects taken by ITSC students is covered and that can be used by anyone who is pursuing some of the country's technology engineering careers. The aforementioned App is expected to be put into practice in the coming months with students from various engineering careers in our institution.

## V. CONCLUSION AND FUTURE SCOPE

The development of the App (MathTech) contains four main modules: main menu module, subject module, precursors module and the configuration or user preferences module. The main menu offers several options such as working in dark mode; this function gives you the option to vary the lighting of your screen with the intention of saving energy from the cell phone battery. Within this structure, the user can view the main topics included in the subjects taught in ITSC engineering careers, with this students could explore future topics to study in their careers. Goals to be achieved by the user are also suggested, with the aim of motivating them to improve their performance and, above all, to achieve them at their own pace. For each module, there are a variety of formulas for different subject such as differential and integral calculus, basic algebra, linear algebra and operation research. Those formulas was selected for math and physics teachers in the ITSC, they concur that formulas are most common to use in physics and math subject and consider this App could be useful for all students.

It is important to emphasize that, the use of the Scrum methodology, given its characteristics, allowed the programming of the App in a very clear and simple way, in addition to presenting various options to improve the interaction between the user (student or teacher) with the App. Scrum has several functions with which you can make animations on the screen and with this, keep the attention of the user and thus continue to be interested in using it. The mobile application was designed to run under the Android operating system from version 5 to the most current with 64-bit format. More, however, it is planned that the next update of the application will be to make it Web Responsive, that is, it can be run from any web

browser. MathTech is available on the PlayStore with a 55 Mb download requirement. Another advantage, in terms of its use, is that it is free and focuses on the TecNM study plans, it is available on different platforms, its design is attractive and innovative, it can be used by teachers and students. In addition, it covers different subjects, and above all it covers the great need for a free mathematics mobile application for higher-level students.

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