

# TABLETS AND APPLICATIONS TO TELL MATHEMATICS' HISTORY IN HIGH SCHOOL

Eduardo Jesus Dias, Carlos Fernando Araujo Jr. and Marcos Andrei Ota  
*Cruzeiro do Sul University, Brazil*

## ABSTRACT

In this article, we suggest that the history in Mathematics Education combined with *mobile* technology, can provide analysis of concepts, theories and significant logical structures in the process of teaching and learning of Mathematics, as the main objective of this study is to analyze the students' motivation and learning using tablets in the classroom. From a collaborative work, high school students have created applications that told a little the Mathematics' history. A private school situated in the east side of São Paulo city conducted this experiment. With the participation of 4 teachers and 107 students of the first year of the high school, we observed that the tablet generated a stimulating and challenging environment in search of mathematical historical elements to explain concepts and theories so far not questioned by students in conventional classes. The results presented in the study indicate that the use of tablets in the work development was of paramount importance not only in the motivational issue, but also in getting knowledge about some mathematical theories put in its history.

## KEYWORDS

Tablet, App, Mathematics, Interdisciplinary, History.

## 1. INTRODUCTION

In the mathematics' process of teaching and learning, the story is a resource that can bring to the educational setting significant educational benefits for the Discipline. According to Miorim and Miguel (2004), there are arguments that enhance the pedagogical use of history in the Mathematic Education, that is, the story ends up participating in the construction of both epistemological as well as ethical nature of mathematical knowledge.

D'Ambrosio (2008, p.29) argues that, "the mathematics' story is a key element to understand how theories and mathematical practices were created". Therefore, we can highlight that the historical factor contextualizes the Mathematics into the classroom and serves as a parameter to give life to facts and human needs. In this article, we have a proposal to discuss the use of tablet in the classroom in a collaborative work. In addition as a mediator object can contribute in the construction of mathematical concepts through the creation of applications that offer social issues, historical and cultural in the Mathematics' teaching, through the study of five civilizations (Babylonian, Chinese, Greek, Egyptian and Indian) that influenced the current Mathematics.

New information and communication technologies become, today, part of a vast instrument historically mobilized for education and learning. It is up to each society to decide what composition, from the set of educational technologies, to mobilize to reach its development goals. (WERTHEIN, 2000, p.77)

According to Teixeira and Brandão (2003) when teachers planned the pedagogical proposal in a way that they view and recognize its potentialities the association between technological resource potential with the area in knowledge may happen. In addition, a teaching and a meaningful learning that meets at characteristics of the current student, in a context of more interactive and dynamic learning will also happen.

The point of this article is that with an inter- disciplinary work involving some areas of knowledge and the use of *mobile* technologies can arouse the curiosity among high school students for Mathematics and make it meaningful? Can we question that the primitive concepts of Mathematics can favor the continuity of

the studies of the current Mathematics? In addition, what would be the true contribution of a project in which it participates a group of teachers and students to build applications that enable the development of historical and cultural thinking in the issue of teaching Mathematics with the use of the tablet?

Looking under these aspects, we realize that we could use these devices (tablets and applications) in our research to try to answer these questions, because we intend to use the tablet as a basic tool in achieving the proposed objectives.

Therefore, this article brings the importance of the mathematical discoveries promoted by ancient civilizations and shows that mathematics, besides being a knowledge that adapts over time, also promotes coherent logics that translate social, cultural and intellectual progress. Mathematical historical concepts were objects of debate among the students involved. The use of mobile resources (Tablets) proved to be important not only for students' acceptance and positive evaluation, but also for the possibility of using technology to gather materials in different formats, bringing to the fore active methodologies for the promotion of interdisciplinary activities.

## **1.1 The history and teaching of Mathematics**

In the process of teaching and learning of Mathematics, history is a resource that can bring to the educational setting significant educational benefits to the Discipline. According to Miorim & Miguel (2004), there are arguments that enhance the pedagogical use of history in the Mathematic Education, that is, the story ends up participating in the construction of both epistemological as well as ethical nature of mathematical knowledge.

D'Ambrosio (2008, p.29) argues, "The mathematics' story is a key element to understand how theories and mathematical practices were created". Therefore, we can highlight that the historical factor contextualizes the Mathematics into the classroom and serves as a parameter to gives life to facts and human needs.

According to Miorim & Miguel (2004), story is "a source that enables the development of a critical thinking, a qualification as a citizen and an awareness and an evaluation of different social uses of Mathematics" (MIORIN; MIGUEL, 2004, p.61-62). The Mathematics that influenced much of humanity was born from small towns organization surrounded the Euphrates river, Tigris and Nilo, because in that region agriculture was the base of support for people who lived there and farmed the land. Faced with this, it is possible to believe that history in Mathematics Education meets the social and cultural changes each time, based on individual needs and collective society. Through the need to count, to organize, to draw and to establish logical parameters that generated ways of communication between writing and thinking built the Mathematics. Gomes (2000) says that the signs are important tools for us to understand the human reality in its values, conduct and expectations generated by their everyday experience.

Using the tablet in the classroom, the teacher can explore the concepts of the Mathematics' history, using images that portray historical pictures of the mathematical context, several texts that tell the story of these people, and videos that historically narrate the development of that Science.

## **2. LITERATURE REVIEW**

### **2.1 The tablet and the project interdisciplinary**

The tablet is a tool in clipboard format and promotes easily access to the Internet and other resources such as notes, spreadsheets, and games, reading books, many applications used both for leisure and for job.

Starting from the assumption that our contemporary society is connected a lot to use new Technologies of Information and Communication, this tool meets the individual and social needs of communication, because according to Vygotsky (1991), the use of mediating artefacts between man and nature, or between man and the man himself, would have key role in social and historical development.

In our research, we consider that the interdisciplinary work allied to the history of Mathematics, could be an important resource in the process of teaching and learning of Mathematics that is, based at the collaborative project between students and teachers we can establish analysis more satisfactory of learning primitive Mathematics.

According to Radford (1997, p. 32, cited by MIORIN; MIGUEL, 2004, p.125) “a process whose product is obtained through negotiation of meaning resulting from social activity individuals, within the cultural context that involves them”. And the mathematical knowledge in particular, as a “symbolic manifestation of certain sensibilities developed by members of a culture through experiences shared and from which the meaning of the products is produced” (RADFORD,1997, p.30, cited by MIORIN; MIGUEL, 2004, p. 125).

Thus, we realize that a collaborative project that involves people for a socio-cultural investigation will make important historical contributions in the mathematical context supported by the use of a tablet and its auxiliary tools, among which we can mention, for example, the internet and the app.

The mathematical content with the new technologies, the High School student shows a different attitude in the classroom. Notable are the desire for discovery and the curiosity of young people to know how the device generated a certain graphic image, collaborating significantly in this process of understanding the correlated algebraic and geometric concepts (ARAUJO JR; DIAS, 2012, p.96).

The issue of the use of tablets at school promoted a dynamic differentiated activity in the classroom, in which the need arose to work together with other areas of knowledge. By theme suggested, we consider necessary the interdisciplinary work, as to Goldman (1979, p. 3-25), “an interdisciplinary look at reality allows us to better understand the relationship between its whole and its constituent parts”. This show us the importance of methodologies in integrated work between the various specific areas of knowledge, in order to build attitudinal elements (FAZENDA, 1994) at the process in teaching and learning.

According to Ruiz & Bellini (1998), we can see the “interdisciplinary as a result of a non-simplified intellectual attitude of the reality approach. This attitude implies admitting that in every situation there are multiple variables simultaneously interfering” (RUIZ; BELLINI, 1998, p.55).

The interdisciplinary approach of these authors make it clear that this field of study is much more comprehensive and complex than we can imaged. We can say that the social historical context of the interdisciplinary reality will promote a coherent intellectual attitude to human needs, but also the enrichment of the joint work of the specific sciences, promoting an intellectual advance of knowledge as a whole.

### **3. METHODOLOGY**

#### **3.1 The resources in drawing up the app**

In the project, participated together with the Mathematics’ area the History teachers (P1), Portuguese (P2) and Computing (P3) and more 107 students of 1st year of High School divided in three different classes. They randomly selected five themes of ancient civilizations that contributed to Mathematics. They are Chinese, Babylonian, Indian, Egyptian and Greek. The purpose of the study was to investigate the origins, cultures, religions, economy, social structure and mainly, the mathematical contributions developed by civilizations investigated. They established an activity delivery schedule to compose a final evaluation, as shown in Table 1. Socio-cultural approach is mentioned for the understanding of the work developed by the students and teachers in the interdisciplinary project.

They divided the activity about the general history of civilizations and the history of Mathematics in three basic formatting procedures. They are: 1) source of research; 2) summary and synthesis of theme; and 3) conclusion or overview of the group about the research.

After this procedure, the students delivered the research on the history of the civilizations to teachers (P1) and (P2) for the correction and possible guidance. The students had a period of one more week for the conclusion and final delivery of the work to the researcher teacher.

Table 1. Project activities deliverables schedule.

General History of Civilization	Delivery Time: 1 <sup>st</sup> Half Aug/13
History of Mathematics	Delivery Time: 2 <sup>nd</sup> Fortnight Aug/13
Formatting Applications	Delivery Time: 1 <sup>st</sup> Half Sep/ 13
Finalization and Presentation of Applications	Delivery Time: 2 <sup>nd</sup> Fortnight Sep/ 13



Figure 1. Resources used by students in developing applications. Source: Research Authors.

The questionnaires have closed and open questions about the findings of mathematical concepts from ancient civilizations, comments from students involved in the project.

In the process of application formatting, we asked to students to elect two representatives team to attend meetings and guidelines in the afternoon with the teacher (P3). These meetings took place in institution laboratory, where they discussed the formatting templates of mathematical applications.

In the first meeting held in the second week of August, attended by 30 students representatives, we and the teacher (P3); at that time, it was proposed the development of some objects. They should contain in the application: 1) history of civilization; 2) history of Mathematics; 3) comics; 4) virtual book; 5) animation; 6) quiz or game; 7) group site and 8) tutorial app.

Occurred two more meetings in the first week of September with the students' representatives and we transmitted technical guidelines for the construction of the project. The collaborative teacher (P3) brought at the time virtual tools that students could use in development and formatting application. In Figure 1, we have images of the resources used by students in project.

We can observe the diversity of resources that the collaborative teacher (P3) offered for students create their App (application) with personal characteristics of each group involved. In the work, the teams created a logo (Online Logo Maker) that should portray team's identity. They produced a questionnaire (Quiz Your Friends) for users to respond and thus generate a concept at the end of the study. They developed a website (Wix) with additional information about proposed project in the classroom and told the history of Mathematics in a relaxed way, using resources such as comics (ToonDoo) and animations (Go!Animate). Finally, they delivered the application to the researcher teacher through an interactive resource called qrcode, as each group of students generated a code for their App and so the tablet reader identified and started automatically the application download process on the teacher's artefact. In Google Play Store, there are many readers of these codes; we used the scan, because it read the codes very quickly and safely. We reaffirm that this resource was efficient to give authenticity of the work delivered

In Figure 2, we have the presentation of one of the applications (group: Chinese civilization) developed by the learners of the project, resulting from research and investigations of both the history and mathematical curiosity, but also the exploitation of available resources for the preparation of app.

We may note some features in Figure 2, because girls formed the group and its logo translated well that gender issue that the teamwork established. We also noted that students cited questions about working with abacus, using fractions, the discovery of the number  $\pi$ , the development of geometry, setting the system decimal and positional numbering using sticks as a numerical representation (1 to 9) and zero as a blank space.



Figure 2. Application developed in group (China). Source: Research Authors.

## 4. THE SEARCH

### 4.1 Data and analysis

They focus on the construction of applications developed by students that told about the history of ancient civilizations and how they influence Mathematics to the present day and their contributions in the learning of elementary Mathematics. We assume that it is through this mathematical historical context experienced by students that we will be able to substantiate the contents taught in the classroom. Through a questionnaire with closed questions, observation, reports and analysis of the applications built, it was possible to verify the degree of learning of basic mathematical historical concepts, and its satisfaction and acceptance of the interdisciplinary collaborative work involving the Disciplines of Portuguese, History, Mathematics and Computing. We monitored the construction of the application and it we found that both teachers and students involved in the project brought important contributions in the process of historical mathematical identification using the tablet and the applications produced in collaborative work that generated and allowed the discussion about Mathematics' history.

The students presented the applications through a seminar proposed by the teacher. Students were individually assessed in their expositions, regarding the learning of the observed mathematical concepts.

In Table 2, we have the students responses regarding the issue that talks about the most important discovery of the ancient people searched:

Table 2. Evaluation of the degree of interest in Mathematical discoveries. Source: Research Author.

What most caught your attention in your research, concerning the Mathematical discoveries?	
Replies	Percentages
The construction of the number system	39%
Geometry	15%
Curious problems	17%
The drawings and images used for counting and troubleshooting	17%
Arithmetic and Algebra	8%
No fact	3%

That frame shows the students' interest and curiosity in observing writing and numbering system as the starting point of ancient civilizations, because it is through numeration system, that Mathematics is present and grounded in the numerical and social foundations of every civilization, investigations carried out by the groups, it is in the speech of student:

*[...] I was intrigued and at the same time surprised when I saw the Chinese numbers, I found it very interesting (Student A).*

It is believed that when students did their research and built the application talking about the numerical system, we agreed that the link between the past and the future, according to D'Ambrosio (2008), provokes in the student some discoveries and concepts for his present, of a living and mutable Mathematics, according to the needs of each civilization. The content managed so that the history of Mathematics will better contextualize its teaching with activities that promote a differentiated dynamics in the classroom so that it does not become an unnecessary content for the students. We believe that the history and the use of technologies resources used in this research favored the learning of topics of which the students were previously unaware. As the interdisciplinary project involving the Disciplines of Portuguese, History, Mathematics and Computing, we verified in our questionnaire that students evaluated very positively the work developed with the tablet and the teachers' support.

We also observed that the interdisciplinary activity will be able not only promote a collaborative autonomy between them, but also will promote attitudes and actions in an innovative way regarding mathematics learning, creating concrete relations of reality in which it lives. (FAZENDA, 1994).

Technological interaction promoted by tablet and its applications were essential for other students to do their placements and suggestions in a way to contribute with the continuity of this work.

*[...] in the tablet the history and an animation got very interesting as well as the application's activities. The application structure in general got very cool and easy to understand content (Student B).*

We note that in this speech the student considers that the structures such as HQ and animations generated by tablet and the applications brought interactive and dynamic elements of motivation action and reaction (LÉVY, 1993). We believed that in these observations the students are in the process of adapting to use the tablets and applications in school dynamics.

We must also to demystify the idea that the teaching of Mathematics is done only unilaterally (teacher – student), that is, there are different ways of learning and not only one.

## 5. FINAL CONSIDERATIONS

We observed that the majority of applications built shows a Mathematics focus on theory and topics that students have already heard in the classroom. Another fact is the report of its social and cultural importance regarding to the civilization inserted in it.

We think that we were able to answer some of the issues and objectives set out in the work, because the historical mathematical concepts were objects of debate among students involved, and realized that we perceived that they argued about texts and mathematical curiosities established by the groups of the same theme.

The teams have positioned themselves through written arguments and shared between them, thus creating moments of reflection about some historical topics of mathematical content.

The learners expressed the importance of the mathematical discoveries promoted by ancient civilizations and indicated that Mathematics, besides being a knowledge that adapts over time, also promotes coherent logics that reflect our social, cultural, historical and e intellectual progress.

History and mathematical discoveries promote reflections, individual and collective motivations so that everyone shares facts, legends, curiosities and episodes (MIORIM & MIGUEL, 2004). History not only grounds the Mathematics experienced by all of us, but it will also be the basis of future mathematical discoveries in the technological advancement of our civilization. These moments will serve as a point of departure not only for the teacher to contextualize Mathematics, but also so that the teacher can establish with the students an analogy of what they are learning in the classroom.

We also emphasize that the interdisciplinary work associated with the development of classroom applications exposes a motivating structure for students and teachers to explore mathematics in a much more dynamic and challenging way. The use of active methodologies makes it possible to construct new ways of learning, the adoption of mobile devices in the classroom emerges as a facilitator of pedagogical actions to promote learning in the current generation.

It is observed in this article that tablet and its resources were fundamental not only to structure the collective work, but to it also helped direct the interdisciplinary work, impacting positively the discussions, debates and the current understanding of Mathematics taught in the classroom. We reinforce that the participation of collaborating teachers in this project potentiated the effectiveness of the results achieved in this research.

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