BUIDING A CONCEPTO OF MATHEMATICAL FUNCTION: DO CONCEITO DE FUNÇÃO MATEMÁTICA: A COLLABORATIVE STUDY ON THE DESIGN AND USE OF "APP" CALLED FUCIONALIDADE

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ABSTRACT

This paper presents the results of a qualitative study about the pedagogical potential of a mobile app called " Funcionalidade ". This app was created as an educational product required by a professional master's degree dissertation, because the study was focused on the development of a technology for practical application in teaching. Its development was the result of collaborative research involving seven teachers of a school located in the metropolitan area of Rio de Janeiro, in a region called Baixada Fluminense. The app aims to assist teachers and students of basic education in the construction of the concept of mathematical function, creating learning scenarios that can lead to be restructuring and improvement of teaching. The work is based on "the theory of conceptual fields" by Vergnaud (1983), and also in the works of Moreira (2011) and Piaget (1969). Conclusion reveals that teachers have an insufficient mastery of technologies that are perpetuated by the school culture. This situation can become an obstacle to learning and innovation. The results obtained from the use of the app were positive and motivating for students. The app "Funcionalidade" helped them to make a link between mathematics and the real life, leading students to apply the concept of function for understanding problems. We hope this app will offer new scenarios for the teaching of math in basic education.

Keywords: technology; teaching and learning; mathematical function.

1. Introduction

There is a frequently a gap between school's proposals and students' everyday interests. It happens that this distance has remained almost constant over the centuries, however, with the accelerated process of technological development, we come to a moment when it is impossible to ignore the rapid transformation of society. We cannot remain indifferent to the changes occurring in the world. According to Borba and Penteado (2001) in terms of mathematics in Brazilian education, the effective learning suffers the action of the mismatch between what is being taught in the classrooms and the numerous advances in science and technology.

The technological advances of the modern world have changed in geometric progression and schools, unfortunately, have changed in arithmetic progression. Schools need to consider the time we live in. It needs to upgrade its teachers, motivate them to use new technologies, because iPads, iPhones, Internet, mobile devices etc, are already in the hands of students. According to Kenski (2011, p. 55), traditional classes, where teacher speak and students respond to questions are not producing the satisfactory results. Students, especially younger ones, begin to "daydream" during classes.

The use of technology in teaching has been the focus of several scientific communities. They have searched for new alternatives to assist in the teaching of mathematics in the XXI century. There are many publications about this issue on newspapers, magazines, journals, Internet, blogs, social networks and in books. Kenski (2011, p. 19) argues that teacher's action in the classroom, and the use of technological resources, which are available to them, should redefine the relationship between knowledge to be taught, the power of teachers and the uses of technologies to ensure students' learning.

In this study, it is necessary to understand how mobiles apps can help teachers in teaching and students to learn concept of the mathematical function. A mobile device, like tablets, can store the textbooks used by students, and also dictionaries, calendars and dozens of tools needed for daily consultations; it can be efficient to find applications to produce text, spreadsheets, charts, calculators; do simulations that are impossible in books in the press format. We know that technological development provides a new dimension that transcends the outdated paradigms of teaching based in programmed instruction, transmission of information. It disrupts the mechanic thinking model of teaching and learning. (Miskulin, 2007, p. 136).

A tablet or a smartphone can simulate models of mathematical function from its most elementary forms, from the functionality idea already into the human mind, with examples and models of the simplest to the most complex and diverse. All these can be accessed with a simple "touch". Virtual learning can happen without the limitations of time or place. In addition, through the app, it can simulate the notion of functionality that already belonged to ancient people and contextualize the concept of function from what students already know - do it all in the same space simultaneously.

This work describes the application FUNCTIONALITY, exploring how it promotes the teaching and learning of the concept of mathematical function, in basic education, using digital media and the educational potential of apps for tablets, Smartphone and desktop, thus developing learning objects as a product of this research. So, we bring the results of a study evaluating, in collaboration with practicing teacher's application potentialities FUCIONALIDADE for teaching about mathematical function in basic education. This study considered the comments made by teachers participating in the project, from their practice by comparing the way of teaching and learning the concept of mathematical function with the application available on tablets, compared to the traditional format.

2 - Initial considerations about the concept of mathematical function

It is important that the student understands the concept of mathematical function, because the study of functions is provided in PCNEM -National Curriculum Guidelines for Secondary Education, and also by the fact that the application of this concept will accompany us through longlife. The concept of mathematical function is present in many different branches of human knowledge and originated probably in antiquity, when scientists, philosophers and other scholars from different branches of science sought to understand ways that allow describe natural phenomena that both intrigued. According to Delgado (2010, p. 23), in daily life, the functions are represented in different ways. For example, tables and graphs are widely used in the media (newspapers, television, internet) while formulas involving functions are used in commerce, science, among others.

The study concept permeates time and, along with it, this concept has developed in different ways at different times in human history, a subject that is not intended to explore in this work, since there is a significant number of articles, dissertations and theses signaling the importance of the study of mathematical functions.

So contextualized understanding the concept of mathematical function is of vital necessity to "know math" and the time is ripe to propose an innovative approach to teaching and learning. With the emergence of new devices such as tablets with their mobility and interactivity, we can use the applications to help build the concept of mathematical function. Are new challenges for mathematics education - are new times. We can take advantage of the capacity of learning objects to simulate phenomena, its portability and its potential restructuring of educational practices and their ability to subsidize these practices, especially of mathematics in basic education, to create different routes of learning.

In this work we try, from an educational product - FUNCIONALIDADE – designed as an apps can help teachers and students about the concept of mathematical function and how to use the concept for different areas of human knowledge.

3 - Methodological procedures

The survey was conducted in Flama System Education and completed in 2014 involving seven of the twelve math teachers from two branch of Flame College – Duque de Caxias-RJ and São João de Meriti - and also the Aquilino Dominguez Quintas School, located in Nova Iguaçu city -RJ and 30 students enrolled in the first year of high school, who were invited to participate by teachers. The selection was made voluntarily. The Flame's System was developed by the Flama School, a private educational establishment in the Duque de Caxias city at Rio de Janeiro state. The Flama School was founded in 1989 by a group of teachers who dreamed of an innovative teaching proposal. It started its activities as a preparatory course for vestibular and another kind of access and competitions. Currently, the Flama System Education has five branch located in three cities and offers from preschool to high school (regular and adult education) and vocational education. It also offers the distance education through three technical courses.

We opted for the participatory research so that permits an active involvement of the teacher. According to Brandão (1987, p. 52), considering the limitations of traditional research, participatory research will help people involved to identify by self their problems, to carry out a critical analysis of these and find solutions appropriate.

The research has been compartmentalized a long the six steps: 1-formal invitation to math teachers Flama School System; 2-interview with the participating teachers; 3- Workshop for presentation and discussion of the project; 4-presentation of the app to the participating teachers in version 1.0; 5-extra meeting with participating teachers aiming to understand their professional careers; 6-student assessment Flama System on FUNCIONALIDADE app.

4 - Technology in the teaching of mathematics and the study of functions

The product and the collaborative study are based on the French line of teaching math - these studies try to understand the history, obstacles and proposals for teaching and learning of mathematics. It has to priorize the study of teaching through concepts, because on the one way, we have the problem of the formation of mathematical concepts, on the other, the training of teaching concepts related to mathematics learning phenomenon. It also seeks the theoretical bases in Vergnaud - in his "theory of conceptual fields".

Vergnaud believes that is the conceptual field an informal and heterogeneous set of problems, situations, concepts, relationships, structures, content and operations of thought, connected to each other and probably intertwined during the procurement process. As so, the concept did not appear isolated, static, since a conceptual field is a set of problems and situations which require treatment concepts, processes and representations of different but closely related.

In FUNCIONALIDADE app, for example, ideas and concepts are linked. We see that many concepts needs to be acquired to build the concept of function, among them as the concepts of adding, counting, measuring, generalization, variable, among others.

5 - The FUNCIONALIDADE app

Unfortunately, in this paper, we are unable to include a complete storyboard of the application. Therefore, we will present the main features of it and its relation to the study of mathematical functions.

The FUNCIONALIDADE is an application that was designed from the concept of "learning objects" understood as [...] elements of a new type of computer-based instruction grounded in the object-oriented paradigm, from computer science. Object orientation highly values the creation of components (Wiley, 2001, p. 3). In short, a learning object can be any reusable digital resource that helps in learning.

The application guides the user to the construction of the concept of mathematical function based on the functional idea. As an educational product, in the sense of its utility and consumption, it can be classified as a learning object via mobile app – has low interactivity and its possible users are basic education students from 9th grade. It was developed in Adobe Flash platform for mobile devices, but can also operate in conventional devices. The version used was 3.0 and requires android system 2.0 or later, taking up a memory space of 28.35 MB.

The first four screens include a brief description of what you will find when browsing FUNCIONALIDADE and introduce the concept of mathematical function. The following screens show a historical overview of the concept of function. There, the user must realize that the idea of functionality was already internalized in the mind of man from the time of the cave. Users should also note that what is being studied today in the XXI century, already existed. Reciprocal tables and associations are used on these animations to contextualize the application of the concept in everyday life, from ancient times to the present.

Moving forward in time, the application takes students to the contemporary context by exploring the concept of functions through interactive situations like the "transformation machine" - Figure 1.



Figure 1. Screens 7 and 8 of FUNCIONALIDADE application

In the transformation machine the user will touch numbered balls and these, after being touched, will slip inside of an engine that will transform the number touched in another, thus if the user touches the -3, as it goes through the "machine", it will turn -7, -2 playing in it will become the -5 at -1 -3 in zero to -1, 1 on 1, 2 3, 3 and 5 finally appear on the x where the response options function, i.e. f (x) = 2x - 1. By ticking the correct answer, the user may have contact with the graphical representation in the Cartesian plane, the function found in figure 3.14 and by touching NEXT, the user will move to the final stage.

6 - Results obtained with the application FUCIONALIDADE

During the research students participated in an assessment focused on the concept of function and answered a questionnaire. About 56% considered that FUNCIONALIDADE provided a better environment for learning functions, being better than traditional resources, such as notebooks, books and the blackboard.

We investigate also how students perceive the way the FUNCIONALIDADE helped them understand the concept of function. Our results revealed that 16.8% found it to be very bad, 16.7% bad, 44.4% good, very good 16.6% and 5.5% excellent. Thus, 66.5% of respondents had a favorable opinion about FUNCIONALIDADE and its potential to help learners understand the concept of function.

If FUNCIONALIDADE were available for free download, 61% of the students would acquire it, whereas in the case of paid download, worth US \$ 1.00, only 22% would make a purchase.

In general, students showed interest and enthusiasm for the use of FUNCIONALIDADE, highlighting the possibility to connect to the application at different locations.

7 - Final Thoughts

The purpose of this study was to explore different formats of learning objects: animations, simulations and images to facilitate and improve the teaching and learning of mathematics, focusing specifically on the concept of mathematical function, given its potential for the development of learning objects with significant potential for use in different contexts.

The results of this collaborative experience with teachers and their students exceeded initial expectations, bringing them together through the use of technology.

Teachers realized that students are able to learn the concept of function from information based in their daily lives. Similarly, students understood that they could experience numerical transformations perceived by them with the help of technology- for, then relate them algebraically. We conclude that FUNCIONALIDADE contributed to the teaching and learning, as 66.5% of students had a favorable opinion on its effects in their understanding of functions. These results encourage investment in this technology, which will be implemented across the Flama Education System.

Although FUNCIONALIDADE is an application still under development, we believe its learning scenarios can contribute to the teachers in their mission to build, along with his students, the concept of mathematical function.

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