MONITORING A TECHNOLOGICAL BASED APPROACH IN MATHEMATICS IN PORTUGAL — THE CASE OF KHAN ACADEMY

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This paper intends to present a project to monitor the implementation of the Khan Academy Platform (KAP), in mathematics classrooms of 1st to 9th grade in Portugal. Based on a partnership between EDUCOM, Portugal Telecom Foundation and the Ministry of Education, a project is underway that involves the training of teachers in the use of the platform (KAP) and its implementation with students from five schools in the outskirts of Lisbon. We present here the theoretical and methodological assumptions that underlie this monitoring, with the objective of characterizing the training of the teachers involved, the students' learning and the role played by the platform in the process of teaching and learning mathematics.

Keywords*: Khan Academy, teacher training, learning platforms*

INTRODUCTION

The use of technologies is a recurring theme in the Portuguese curriculum. Since the 80's of the last century, several methodologies have been proposed that involve the use of technology as a learning tool. For the implementation of these methodologies it is necessary, on the one hand, to prepare teachers, equipping them with skills and knowledge that allow them to integrate the computational tools into their professional practice. On the other hand, it is necessary to plan the activities to be developed in order to integrate the computational tools in the mathematics class, giving visibility to the *modeled curriculum* and *curriculum in action* (Gimeno, 2000). It is expected

that actions focused between these curriculum levels and the use of technology lead to more solid and lasting learning by the students.

Based on these assumptions, a pilot training project for teachers using the Khan Academy Platform is underway in a partnership between three institutions: EDUCOM, Portugal Telecom Foundation and the Ministry of Education. This project involves the realization of two Training Workshops, with a total of 30 teachers of Basic Education (1st, 2nd and 3rd Cycles). These workshops have a total of 50 hours of training, distributed throughout a school year, where teachers mobilize half of this time for in-person training to work with the platform (KAP). The remaining hours are designed to work in class with their students. This project also provides for a second year for the implementation and improvement of practices initiated with the training process.

The Platform (KAP), translated into Portuguese, presents a vast set of functionalities where it is possible to visualize videos about specific topics, perform exercises and tasks proposed by the teacher, while it is possible to monitor all the actions carried out by students enrolled in this environment. The fact that this environment have a game character has shown a strong support by the students involved in it.

In this paper we discuss the underlying theoretical assumptions, as well as the research methodology that allows us to monitor the actions of the different actors (trainers, trainees and students) in the different interactions with the platform (KAP) and its integration in the curriculum and the teaching and learning process.

THEORETICAL FRAMEWORK

The theoretical constructs called for the foundation of the work that is intended to be carried out in the monitorization of this project, are essentially based on three dimensions: a) activity theory, b) professional knowledge of teachers and c) students' learning. With activity theory (Engeström, 2001), we intend to broadly frame the actions of the various stakeholders in the project. In this way we can characterize the actions of the various actors in the integration of the technological tool in use. We thus seek support for the processes of instrumentation and instrumentalization (Rabardel 1995) which will help us to interpret how teachers and students relate to technology in general and the platform in particular, reinforcing the semiotic power of the artefact (Bartolini Bussi & Mariotti, 2008).

In order to clarify the way in which teachers take ownership of the artifact, we use the notions of professional knowledge of teachers, where knowledge of content, pedagogical knowledge and technological knowledge are framed (Ball, Thames, & Phelps, 2008). In order to characterize students' learning, we will also use the activity theory, establishing and comparing the different systems of student activity when involved in working with the technological tool.

Activity Theory

Activity Theory initiated by Vygotsky and developed by Leont'ev, assuming its system of collective activity (object oriented and mediated by artifacts) as the unit of analysis, has been developed over three generations. Was initially based on the idea of mediation introduced by Vygotsky in his triangular model that becoming the triad subject - object - mediator artifact, leaving behind the separation between the person and the social environment (Engeström, 2001). In the second generation, centered Leont'ev the unit of analysis is no longer individual and now includes links to other areas involved in a collective activity system, focusing now on the interrelationships between individual objects and communities. The third generation of activity theory could be summarized by Engeström (2001) seeing the object of activity as a moving target for an expansive transformation in activity systems supported by the contradictions as a source of development.

These contradictions are not conflicts since it evolves a dialectic and multi-directional relation supported by Marx and Hegel in the contradictions of the dialectic relation (Figure 1).

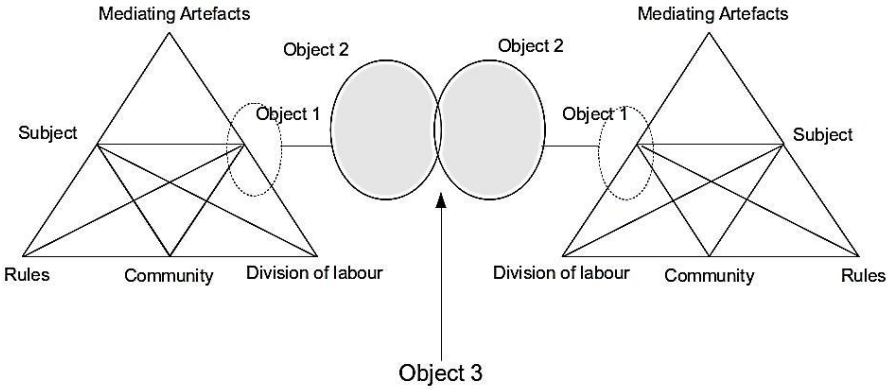

Figure 1 – Interaction between two systems of activity (Adapted from Engeström, 2001, p. 136)

Human activity is mediated by cultural artifacts, which are culturally, historically and socially produced and reproduced, by means of complex and multidimensional relationships (Engeström, 1999). Artifacts have possibilities for action that the user may or may not use. We are concerned with the ways in which teachers appropriate these artifacts, or, following Drijvers and Trouche's (2008), terminology how they become instruments. Instrumental genesis (Rabardel 1995), therefore, is the progressive construction of schemas of use for an artifact by an actor for a given purpose, which was adapted to the study of teaching and learning mathematics by Artigue (2002), Ruthven (2002), particularly in technology-mediated learning. The instrumental genesis will be deepened here in order to understand in depth how the different actors relate to technology and the platform. Although this relation is present in the Activity Theory, it is intended to give a special emphasis to this relation because it represents a very important aspect of the relation between the subject and the artifact.

With the use of technological artifacts it seems to be crucial consider the notion of semiotic mediation (Bartolini Bussi & Mariotti, 2008) to enhance mathematics teaching and learning. In this context, it is important take into account the semiotic potential of the artifact that involves two semiotic links, one between the artefact and the personal signs that emerging from its use and the second between the artifact and the mathematical signs evoked by its use and recognizable as mathematics by an expert.

Professional knowledge of the teacher

The current education systems are organized around a set of dimensions which give it a structure and a coherent organization, which believes it can boost its development and impact on the preparation of future generations. The role of the teacher is considered as one of these dimensions, occupying a central position throughout the process. Given this premise the professional development of teachers becomes a fundamental element so that the process of teaching and learning has the desired impact on students and the educational community in general.

Several studies have been addressing this issue, focusing sometimes on the curricular dimension as a way to promote success, namely success in mathematics. Ball (2003) considers that this intervention is only effective if it is focused on the way teachers teach "In curriculum teaches itself, and standards do not operate independently of professionals' interpretations of them" (p.1).

The mathematical knowledge for teaching has thus been a concern of many researchers seeking to identify and discuss the various domains that this knowledge involves.

Ball, Thames and Phelps (2008) use the notion of knowledge of pedagogical content of Shulman (1986), which refers to the existence of knowledge of unique content to teach, trying to identify the competences of teaching, starting from an empirical approach, to understand the knowledge of the content necessary to teach (figure1).

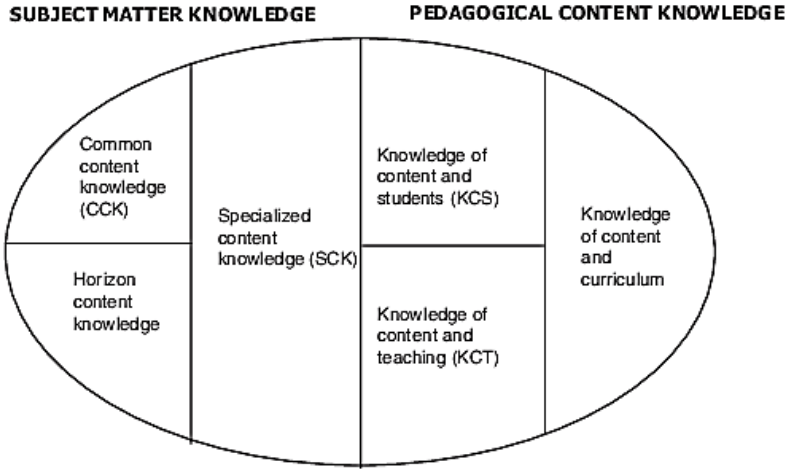

Figure 1: Mathematical knowledge domains to teach (Ball, Thames, & Phelps, 2008)

Given that we live in an age marked by technology and the role of computational tools, Koehler and Mishra (2009) extend TPACK (technological pedagogical content knowledge), which they consider to be teachers' pedagogical knowledge to integrate technology. Koehler, Mishra and Cain (2013) add that the interaction of these forms of knowledge, both theoretical and practical, yields the types of flexible knowledge needed to successfully introduce / integrate technology into teaching. The TPACK results from the intersection of content knowledge, with pedagogical knowledge and technological knowledge (Figure 2)

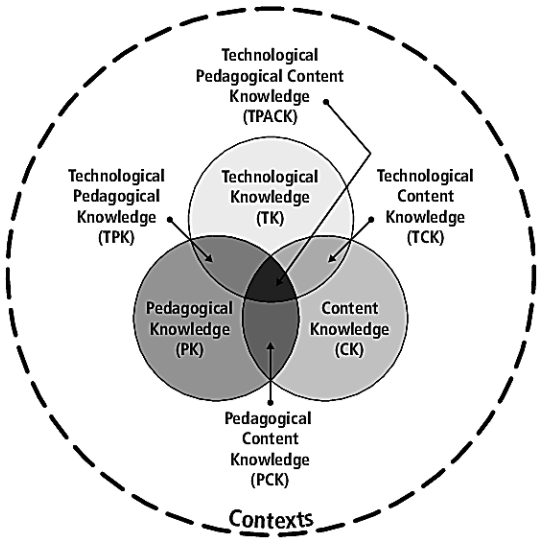

Figure 2: Domains of technological knowledge (Koehler, Mishra, & Cain, 2013)

The identification of these dimensions becomes an asset to create learning opportunities for teachers, since one can not expect that they know or do what they had no opportunity to learn. In this sense, the careful development of courses, workshops and well-designed and managed materials is fundamental (Ball, 2003). It is in this sense that the work with the trainees has been developed, involving them in the use of the platform, both as learners and as teachers of their students in the computational environment.

The theoretical framework presented here establishes and maintains the main constructs to mobilize in monitoring the implementation of the Platform (KAP) in basic education schools involved in the project. This is still a macro perspective who will be detailed as the study progress on the ground. The students' learning will be subject to a deeper analysis taking into account the specificities of the Platform and classroom orchestration conducted by the teacher.

METHODOLOGY

The development of this monitoring study can be considered as a mixed study from the methodological point of view. The qualitative dimension is mostly present in monitoring actions. It involves a descriptive and interpretive analysis of teacher training processes, their appropriation of the technological tool (KAP), the integration of this tool in their pedagogical practice and the students' learning when using the platform. Due to the intrinsic characteristics of the platform, it is possible to monitor student performance in solving the tasks and challenges proposed. It is thus possible to quantify the evolution of the students, from the time it takes to solve each task, the number of hits and errors committed, the working time devoted to each task or subject, among others. The triangulation of these two approaches will allow a better understanding of both the formative process of the teachers and the learnings carried out by the students. It is also intended to carry out some case studies, both with teachers and with students, in order to deepen the different types of knowledge developed.

To develop this monitoring work we used essentially on three analysis tools. One of these tools intends to synthesize an inventory to analyze a task. This inventory involves the following categories: content, process and task type (Pepin, 2012). In the corresponding category of content are taken into account the content domain and connections with math. In the category of processes, in addition to the processes of representation, analysis, interpretation and communication, are taken into account the connections with mathematics. In the category referring to the type of task, procedural fluency, familiarity, context, conceptual understanding, cognitive requirement, mathematical representation and the tools used are taken into account.

The second tool is related to the type of feedback and relationship with the activity, which involves the following phases: Literature review, Development of task analysis scheduling, Task analysis, Assessment, task analysis and national curriculum and Learning steps (Pepin, 2012). These phases involve the following types of feedback: reflexive and diagnostic.

The third tool involves an inventory for the analysis of an artifact produced with a technological resource for the actions in class. In this inventory are highlighted different types of task and their relation with the work to be developed by the student (Teixeira, 2015).

The techniques of data collection are varied and serve different purposes. Teacher training is accompanied by a non-participant observation, where teachers are followed in all training sessions. Field notes taken during the training sessions, the semi-structured interviews with trainers and later with teachers, seek to realize some of the dimensions of their professional development. The

observation of teachers' classes when using PKA and the participation of students in these same classes help to understand the process of instrumental genesis in teachers and students. Conducting interviews with students, who will be involved in specific case studies will assess on their learning at the same time that these qualitative data are being crossed with quantitative data provided by KAP.

Participants in the study are teachers from five schools in the west of Lisbon, a total of 30 teachers and 700 students of classes belonging to these same teachers (1st through 9th grade). Teachers are involved in a 50-hour Training Session (25 classroom and 25 at distance, in class work with their students). The training process involves introducing teachers to the platform (PKA) and its use with students.

After this process of instrumentation teachers are invited to develop learning paths based on KAP that will later implement with the students. All students were enrolled on the platform (KAP) and are followed in the course of two processes: the implementation of learning pathways previously designed by teachers and performing specific tasks on the platform that are suggested by teachers as a training supplement taking into account the performance that students demonstrate on the platform.

IN SUMMARY

The project is currently in an early stage with the teachers finishing a phase of appropriation in the use of the platform. The development of lesson planning using KAP is ongoing, depending on the curriculum topics that each teacher intends to implement. Along with this approach, students have already been introduced to the platform (KAP) where they are developing some concepts review tasks, with teacher supervision.

Throughout this process it is possible to identify a general satisfaction of the teachers because they belong to the privileged group that integrates this pilot project. It is possible to see that a large part of the teachers involved are taking the first steps in introducing the technology in their classes, showing a dynamics and involvement that was not observable at the beginning of the training process. The students involved are also very motivated. It is possible to verify that most of them have already used the platform to make their first experiences, and some are already reaching levels of excellence in the field of some elementary concepts. The fact that the platform (PKA) has a strategy game has been singled out by teachers and students as an asset to the strong interaction that comes to check.

The lack of equipment in schools, to ensure fair access to the platform, has been the main problem detected. Many of the student accesses are made from home, out of school hours. Accesses from school are still unsatisfactory, with some students expressing dissatisfaction with the orchestration of classes, where only part of the class can access the platform, while other students are invited to develop paper and pencil tasks.

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Revisão do paper

Notation Grid

- Focus and rationale : 6 - Research question to be precised
  The paper presents a project of in-training sessions aiming at using the Khan academy platform in the classes.
- Theoretical and methodological (TMF) : 6 - TMF might be further improved
  What I miss is the articulation of the different frameworks that are presented. For example, is it necessary to have references to the instrumental genesis and what does it brings that is not studied through the activity theory?
- Statement and discussion of results : 3 - Missing or unfounded results
  The weaknes of this paper in my sense lies in the absence of significative results both regarding the in-training and the effective interest of the use of the platform in the maths classes.
- Clarity and relevance to ICTMT 13 : 6 - Relevant but needs further improvments

› Comment author

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