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► **To cite this version:**

Fabrice Vandebrouck, Barbara Jaworski. Role of tablets in teaching and learning mathematics. Eleventh Congress of the European Society for Research in Mathematics Education, Utrecht University, Feb 2019, Utrecht, Netherlands. hal-02428891

HAL Id: hal-02428891

<https://hal.science/hal-02428891>

Submitted on 6 Jan 2020

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Role of tablets in teaching and learning mathematics

Fabrice Vandebrouck¹ and Barbara Jaworski²

¹Université Paris Diderot, LDAR, Paris, France; vandebro@univ-paris-diderot.fr

²Loughborough University, Loughborough, UK; B.Jaworski@lboro.ac.uk

Keywords: Mathematics learning and teaching, secondary level, tablets, activity, actions, goals.

Introduction to the research question

The poster focuses on teaching and learning mathematics in three secondary classrooms in Paris, through the use of digital technology in the form of tablets. We are interested in the interactivity of teacher and students and the roles played by the tablets in engaging students with the mathematics in focus. We see tablets as tools used to satisfy the goals of both the students and the teacher in relation to their actions in the classroom. Here we use the language of Activity Theory which we take as a theoretical basis for our analysis of classroom activity. Indeed, taking the tablets as a focus, understanding their role in the teaching and learning of mathematics cannot be investigated without consideration of all the Activity in which they are used. Our broad research question about the use and role of the tablets for this study can be reformulated as follows: in what ways are the tablets engaged in the Activity (or Activity systems) which take place in the mathematics classroom?

Methodology

We observed three lessons in which tablets are involved. We adopted a methodology which fits with Activity Theory as well as some French developments in the field of didactics of mathematics (Vandebrouck, 2018). For instance we include an *a priori mathematical analysis* in which we outline the mathematical knowledge or concepts to be addressed by students, the way these concepts are addressed by curriculum, epistemology, mathematics, and the difficult ideas which are evident to us from our didactical experience (the mathematical *relief* of the concepts according to Robert cited in Vandebrouck, 2018). We use didactical tools to analyze students' tasks (Horoks and Robert, 2007) as a way to understand both some of the teachers' motives (in relation with teaching mathematics) and the student's actions (in relation with these tasks). Videos showing classroom actions and interactions provide some evidence of the students' and teachers' actions and what students achieved in relation to the goals to be reached.

Following Engestrom et al. (1999), the units of analysis are then the Activity Systems that are collective, tools (or artefact) mediated and object oriented: actions are understandable when interpreted against the background of entire activity systems. Analysing teachers and (some) students' actions/interactions, we identify Activity Systems in the classroom (in reference to different teachers' motivations or students' motive/goals). Analysing the Activity Systems permits us to understand the effective use of *tablet-based tasks* by students and the role of these tasks as teacher' tools to which the outcome of the activity is a response. We highlight the way these systems evolve during the teaching process with tensions and perturbations (Abboud, Clark-Wilson, Jones, Rogalski, 2018). In particular we highlight those systems where the tablet plays a role, in

order to address ways in which the tablets contribute to the teaching and to the students' mathematical learning.

Results: tablets between the individual and the collective dimension of activity

In the first lesson, the tablets are tools to support a task with GeoGebra. They permit organization of the session in a traditional classroom (rather than in a computer laboratory) and are expected to favour communication between students in small groups. However, each student has his or her own tablet and the mathematical task is given in the tablet environment. So there is not really a need for communication between students. Moreover, the configuration of the classroom (small groups of four students) does not permit a whole class discussion and an organization of the Activity System in order to overcome this absence of communication between students. It seems that the tablets act as barriers for the collective dimension of activity which was one motive of the activity. In the second lesson, the situation is quite similar. However, the discussions occur among pair of students since there is only one tablet for each pair. Nevertheless, a tension appears between the pairs of students who succeed in the given task and the pairs of students who do not. So, the teacher organizes a new activity system with a reduced objective and a reorganisation of tools. The new motive is the success and understanding of all students in the task. The teacher gives his own tablet to a pair of students. This tablet is projected onto the board so that all the students can watch and follow the steps of the construction under the teachers' whole class instruction/discussion. The collective discussion is possible because of the classical organization of the classroom (not in small groups).

In the third lesson, students are supposed to investigate their previous knowledge in a relatively autonomous way in small groups as in the first lesson. The tablets are tools to provide several exercises (using Wi-Fi) and the tasks are solved on paper with pencils. Then students work together. The tablets are also present to provide a new kind of task for students: making collective videos for explaining their procedures and results on some exercises. This is also a way for the teacher to draw attention to some tensions between students. Indeed, tablets and videos allow the teacher to project solutions of some tasks onto the board and they foster class discussions. As in the second lesson, the tablet is then a fundamental tool in the teacher's activity system, compensating for the original organization with small groups and individual aspects of the session.

From our analyses of data from the three classrooms we see ways in which the tablets take a central role in the Activity Systems involved. These will be shown briefly within the poster.

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