Learning of robotics in primary school

Which studied concepts during which activities?

Michel Spach – The University of Paris Descartes
Georges-Louis Baron – The University of Paris Descartes
François Villemonteix – The University of Cergy-Pontoise

Didactique et apprentissage de l'informatique à l'école

Abstract

This research is a part of a selective project led for the Research Agency, ANR: "Teaching and learning computer at school" (DALIE) [6].
It focuses on teaching practices in Computer Science by teachers, non-specialists in this discipline, experimenting in classrooms:

- **what teaching situations using educational ground robots?**
- **what didactic appropriation of knowledge objects?**
- **what teaching aid and for which activities?**

It analyzes how these teachers have coped with computational thinking in action and how they could develop this form of thinking among students. It has been conducted in two classes of primary schools in the Paris region (14 sessions from November 2015 to June 2016).

Context

- Approach by the **conceptualization** : understanding what happens behind the screen [2].
- **LOGO** (1980): Implementation of educational situations to develop a form of procedural thinking [4].
- New ground robots (**Bee-Bot, Thymio**), smaller and more independent. Researches on Bee-Bot [8] show that this kind of robot has a real "cognitive potential" [5] for the development of skills in the field of mathematics and thought algorithmic.

Design approach

Framework of didactic and ergonomic psychology to analyse the educational processes among teachers and students:

- construction-based **robotics activities** analysis [3]
- French theory of **conceptual fields** (Vergnaud, 1990) to analyse the learning process of IT concepts
- **instrumental approach** (Rabardel, 1985) to understand the genesis involved during instrumented activities
- **didactics of informatics** [1]

Methodology

Three different kinds of analysed data:

- **videos sessions**
- **interviews with students and teachers**
- **traces of activity**

Inductive approach by adopting a peripheral participant observation approach that can “understand some difficulty decrypting mechanisms”, [10] avoiding to cause any change.

Categorised data	→ Grids	→ Analysis
Filmed observations (group and class)	*Activity observation grids*	*Relevant notions and concepts*
Interview of teacher and a group of students	*Pre and post scenario interview grids*	*Pedagogical scenario*
Teaching and student activity documents	*Documents analysis grids*	*Pedagogical tools*

First results : teachers, robots and scenario

Teachers: in capacity to integrate, in a pragmatic approach, these robots in learning sessions they design, incorporating pedagogical tools which are often transpositions of existing tools.
Robots: suitable to experimental trial and error, they are part of learning situations during when students cab reinvest table, kit and educational materials. The anthropomorphic characteristic remains pregnant in the words of the students.
Scenario: participates in learning of computing concepts and shows the existence of instrumental genesis, both among mobilized robots and other artefacts becoming instruments including symbolic (concepts, notions) or school materials (cross-ruled board, coding table) arguing manipulations and strategies developed.

First results : studied concepts

Relevant concepts by robot:
BEE BOT (simple guidelines of programming)

- single-step program (single instruction) to multistep program (several instructions)
- procedure: part of program
- memory: to do, to Redo and to erase

THYMIO (program, view of the black box)

- concept of program
- identification of input / output parameters
- concept vs anthropomorphism ("detects" vs. "is afraid“)
- link between concept and computer technology

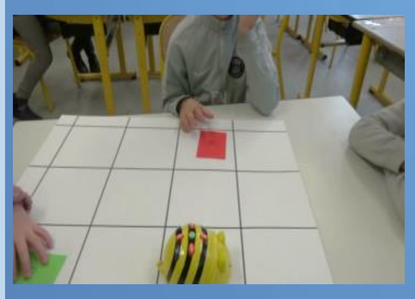

Figure 1. Wide cross-ruled board

Figure 2. Synchronization of movement

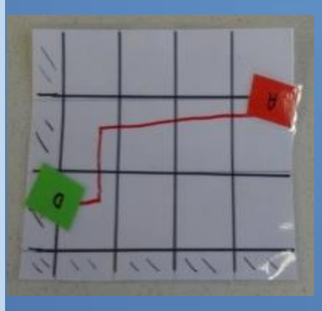

Figure 4. Small cross-ruled board

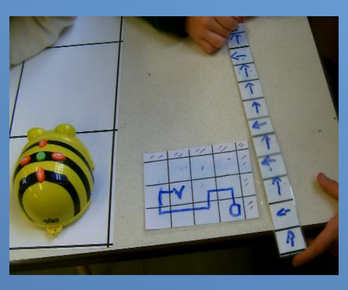

Figure 3. Coding table tile

Next steps

- What **impact of didactic artefacts** on the students activity?
- What use of the **pedagogical tools** (*coding table, observation grid, programming grids*) **and for which purpose** ?
- What **roles of the three elements** (*teacher, student, concept*) of the triangle of J.Houssaye and **what links** (*teaching, learning, training*) between them ?
- What **feedback** from the teacher on his own scenario ?

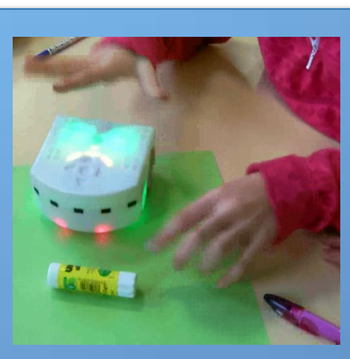

Figure 7. Using school material

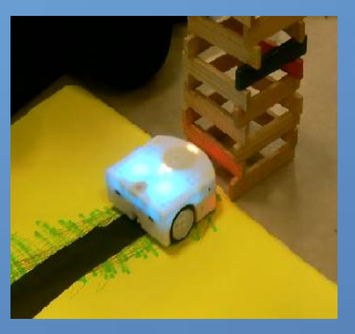

Figure 8. Thymio follows the black strip of paper and moves towards the tower

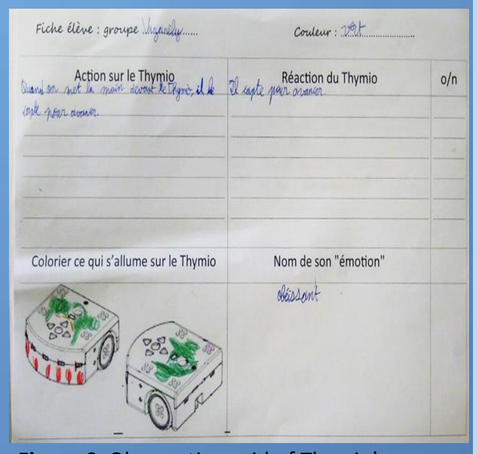

Figure 6. Observation grid of Thymio’s behaviour

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Contact

Michel Spach – The university of Paris Descartes,
Mail : michel.spach@etu-parisdescartes.fr