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Cooperative engineering in mathematics in Joint Action Theory in Didactics

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This proposal aims at documenting the effects of cooperative engineering on the construction of the continuity of teaching experience in mathematics. This research builds on a larger French national research, Arithmetic and Cooperation at Elementary School (ACE). It comes within the scope of a political will to improve teaching practices by providing practical assistance to teachers, offering a complete arithmetic progression to 6-7 year-old-students (First grade). The heart of this research is the conception of a curriculum including activities grounded on the construction of the concept of number. The conception of this curriculum relies on available scientific knowledge in different areas (Cognitive Neuroscience, Science of Education, Developmental Psychology and Didactic of Mathematics).

In this proposition, we focus on a specific part of the conception of the curriculum within a cooperative engineering. This engineering consists of two spheres (Sensevy, Forest, Quilio, Morales, 2011), the sphere 1 gathering a multi categorical team (PhD, teachers of the study classes, researchers, teachers trainers, pedagogical advisors) and the sphere 2 being constituted by the 120 experimental classes. The sphere 1 in the first year of the experiment (2011-2012) designed mathematics' situations focusing on the construction of the number through the seminal conceptual techniques of decomposition/composition, decimal notation, topological approach and approximation. The sphere 1 has designed the first year eleven modules corresponding to forty-five sessions. These situations are implemented in the four teachers 'classrooms, which are named « study classes », and redesigned on line in the course of the implementation process. The second year of this experiment, this curriculum has been implemented in 60 experimental classes and in 120 experimental classes the third year (2013-2014). The involvement of the experiment classes in this curriculum and their feedbacks allowed improvements of the initial design proposed by the research team situations.

In this communication, we will try to show how collaboration between the two spheres has led to educational decisions for a better continuity of the educational experience of the students. For this, we will present the type/kind of monitoring carried out in cooperation between the two spheres. Indeed, the second year of experimentation, members of the sphere 2 exposed via the website the difficulties encountered by students during the introduction of a system of representation of the number (the number line). To overcome this difficulty, the sphere 1 proposed a monitoring "on line" by developing a new version of a unit. After a week of training at the end of the year with the experimental classes, the research team has redesigned all of the first three units of the progression to the third year of implementation. The question is whether this example of cooperation between the two spheres on a particular mathematical object has improved the continuity of the student experience?

Our analyzes will build on the Joint Action Theory in Didactics (Sensevy, Mercier, 2007; Sensevy, 2011) learning which originated in comparative approach to the didactics (Mercier, Schubauer-Léoni & Sensevy, 2002).

Theoretical tools from the “JATD”, we use mainly the concepts of contract/”milieu”, didactic equilibration, epistemic games and learning games (Forest, Gruson, Loquet, 2012).

We use also tools and concepts from mathematics (Brousseau, 1997), more precisely the concept of the time of situation (Sensevy, 2011, 2012) and the concepts of continuity and experience of John Dewey (Dewey, 1916/2011, 1967/2011, 1968/2006).

Methodology or Methods/ Research Instruments or Sources Used

The methodology uses in this research a reflexive work in a cooperative engineering in which a collective of teachers and researchers implements and re-implements a class sessions on a mathematics topics in iterative process (inspired by the lessons studies (Miyakama & Winslow, 2009, Elliott, 2012) and the learning studies processes (Carlgren, 2012)).

Firstly, the meetings between members of the sphere 1 and monitoring meetings between the two spheres were videotaped and transcribed. At least one session of the eleven units was videotaped and transcribed in study classes (sphere 1) and in experimental classes for two years. The processing of all collected data was performed using the software Transana. Besides texts, other pictures (photographs or films) can be put in relation with the study film, in particular photographs of student’s production, series of photograms which may enable to freeze and to study some important moments of the study film, etc.

Secondly, we collected and transcribed comments posted on the research website and the mailing list describing the difficulties faced by teachers in the experimental group in the implementation of sessions, and the responses of the research team.

Different scale-levels were addressed in this research, from the macroscopic level on long duration (articulation between sessions) to the microscopic level to observe minute didactic transactions through an intermediate meso level, which one may see as a pivotal level for the inquiry.

Conclusions, Expected Outcomes or Findings

This research attempts to show how can create a dialogic density between research teams and teachers and how this cooperative and collaborative work can lead to improved learning, particularly through the strengthening of epistemic continuity students in mathematics.

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