What is the engine of teacher development? CPD programmes vs teacher experience

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This paper tackles the question of factors which underpin teacher competences development; it is drawn both upon a set of research from the European project S-TEAM[1], and upon data collected in science classrooms. We will figure out to what extent teachers' approaches and practices with respect to inquiry based science teaching [IBST] could be altered by teacher education and training programmes or by teaching experiences. These two ways for enhancing teacher competences do exist within international expectations towards teachers. Currently, we could be concerned with a trend in many European countries, and specifically in France, which leads to maximize the role of teachers experience and so to minimize the effects of formal CPD programmes.

1. A continuum of teaching approaches and practices

The first problem we have to handle with is the way of identifying differences among teacher practices and conceptions.

Most studies about teachers' practices use two broad and opposite categories: the teacher-centred and the learner-centred approaches. The former is seen as a way of teaching in which students are more or less passive and the latter as a way that facilitates student's learning processes. Nevertheless, numerous researchers had shown variations within these broad categories and they had conceived them as two poles of a unique continuum (Hudson, 2007).

The model we are elaborating will be drawn upon continuums of IBST conceptions and practices. One pole of these continuums will emphasise the teacher and content-centred approaches. The other pole will focus on students and learning-oriented approaches. These poles are not exclusive and opposite. We hypothesize that teachers and teacher educators locate themselves between those according to different factors that are included within the teaching context (available resources, exchanges within their department, etc.). Most of time, this location is quite unconscious but we might assume that the more teachers are aware of it the better their competences improve.

2. A system which organise professional knowledge

The second problem we need to address is the way teachers and teacher educators, as other actors in other professional sectors, elaborate knowledge about their activities.

Studies in vocational fields showed that actors elaborate knowledge about their work as a synthesis of knowledge that arises both from their education or training and from their lived experiences. This synthesis occurs when actors can overcome the contradictions between what standards and instructions imply, what theoretical knowledge indicates, and what professional reality shows. This knowledge concerns not only current actions but also the work process itself: thus it is called as work process knowledge [WPK] (Fisher, & Boreham, 2004).

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Others studies, from a similar framework, focus on the organization of the professional knowledge. Researchers show that this knowledge is not fragmented but linked in a system that allows actors to act rapidly, relevantly, and efficiently. This activity system [AS] is oriented by the activity's object, and it depends of the work organisation, of the professional community's culture, of the available resources and tools within the situation, and also of the repertoire of actions which are mastered by the actors (Engeström, 2000).

According to these outcomes, we had specified what teacher knowledge is and how to grasp it (Grangeat & Gray, 2007). It results firstly that teachers' activities are oriented by knowledge which overlaps their current tasks and concerns the schooling process itself (i.e. school project, curriculum, etc). It results secondly that the set of teacher knowledge is organized as a system according to the main dimensions of the activities. Teacher knowledge may be identified according of four elements:

1. Goal: the teachers' purpose that is held individually or collectively
2. Clue: the piece of information that is picked out from the teaching situation, that is seen as relevant by teachers, and that will activate specific teaching practices
3. Repertoire of actions: the teaching practices that had been triggered by the clue and was orientated by the goal
4. Reference knowledge: the set of knowledge that enable one situation to be matched to another in order to define and to justify an action

This knowledge is adapted to the actual situation of each teacher. Within this situation, many factors alter the activities and the set of knowledge that is necessary for monitoring them: the grade level of the class, the specificities of the students, the content to be taught, the way the teacher masters this content, etc. Nevertheless, within each specific situation the set of knowledge used by a teacher could be identified. Henceforth, we will call this cognitive unit Teacher Work Process Knowledge [TWPK]. Teachers gain to organize these clusters of knowledge within a system according to the crucial aspects of the situation, as it happens for expert teachers. Henceforth, we will call this set of knowledge a Teacher Activity System [TAS].

This TAS may develop through two main factors: the individual history and experience which provide opportunities to enlarge the repertoire of actions; the education programmes which lead to renew the set of reference knowledge. Research findings are coherent and lead to conceive this development of professional competences as an evolution of conceptions and practices between two poles: the first one is centred on the core of the activities (e.g. as a teacher I have only to expose specific contents as clearly as possible to a whole class); the last one is open to the variability of the situations (e.g. as a teacher I have to consider the school collective projects and to act with equity towards all the students). This development could be identified through different modes from novice to expert but each mode doesn't consist of a definitive position: facing a new content or an unknown situation, an experienced teacher could act like a novice. These modes are not exclusive since expertise consists in playing on the whole continuum, being more or less aware of this.

3. Elaborating a model for a better understanding of science teacher activities

We had set out the main dimensions of IBST methods by analysing the S-TEAM products and we found out six dimensions: origin of questioning, nature of the problem, students' responsibility in managing the inquiry, teacher's acknowledgment of students' diversity, role of argumentation, and explanation of teacher's goals. To specify the four modes of each dimension, we observed and

interviewed 20 science teachers which are novice, experienced or expert ones. They teach maths, sciences or technology in lower secondary schools. The TWPK of these teachers were used to specify each mode on the six dimensions (see appendix 1).

The researchers asked each ST to carry out a lesson which he or she considered as an IBST lesson. The lesson was videotaped from the back of the classroom. Afterwards, each ST was interviewed about the video. The ST was asked to stop the video when there was an event which had involved him or her in choosing among different alternatives. Doing that, STs were led to make explicit the goals which underlay the observed action, and the other components of their TWPK. Interviews had been fully transcribed and a text analysis had been used for extracting the TWPK and TAS from the transcriptions. On each dimension, each ST is given a score.

In order to test the model's validity, three groups amongst the 20 teachers will be compared. The commitment science teachers group [CST] consists of 8 sciences teachers. They are involved within CPD programmes based on teacher collaboration. The new science teachers group [NST] consists of 6 beginner teachers. During their first year as teacher, they intended to a specific training programme based on cooperation and controversy. The third group gathers 6 experienced science teachers [EST] who could only apply on their experience. Groups' medians were compared.

4. Comparing science teachers approaches and practices of IBST methods

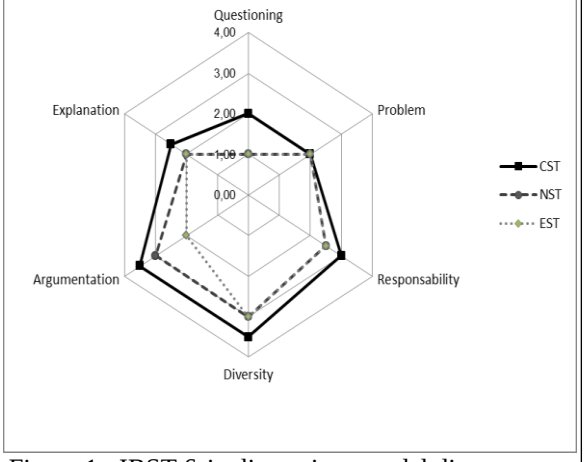

Figure 1 : IBST 6six dimensions model diagramme

The results show that CSTs' group reaches the upper modes of the model for 4/6 dimensions, NSTs' group for 3/6 dimensions, EST group reaches only for 2/6 dimensions (see Figure 1). Nevertheless, through the 3 groups, 'questioning' and 'explanation' are the dimensions which seem the most teacher-centred.

Consequently, within this sample, teacher experience cannot be evaluated as sufficient in order to develop IBST methods. Conversely, the development of complex methods in classroom, such as IBST, is supported by collaboration among teachers and with external professionals, such as teacher educators or researchers.

This strengthens the research methodology and the validity of the IBST 6 dimensions model.

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Content-centred approaches			**Learner-focused approaches**
Dimension 1: Who initiates the questioning?			
1.1- Teachers elaborate the questioning on their own	1.2- Teachers elaborate the questioning after considering students' concerns.	1.3- Students' questioning is fostered through challenging situation elaborated by teachers.	1.4- Students elaborate their own questioning from a theme introduced by teachers
Dimension 2: What is the nature of the problem?			
2.1- Closed problem: students have to follow a narrow protocol.	2.2- Quite closed problem: students need to elaborate their own hypothesis and protocol within a well-known situation.	2.3- Quite open-ended problem: students have to cope with an open task and limited material already prepared.	2.4- Open-ended problem: students need to elaborate their own hypothesis and protocol.
Dimension 3: What is the students' level of responsibility within the inquiry process?			
3.1- Teachers steer students through all the different stages of formal inquiry process.	3.2- Teachers monitor students towards different ways to achieve the task.	3.3- Students are responsible of the inquiry.	3.4- Students rely on material which facilitates self-regulated learning.
Dimension 4: How is managed the students' diversity of knowledge, needs and wills?			
4.1- Teachers cope with specific pupils' behaviour in order to involve them within the inquiry.	4.2- Teachers adapt the task in order to maintain specific students' involvement.	4.3- Each student's team receives teachers' supervision.	4.4- Students with specific needs rely on specific adaptation of the inquiry situation.
Dimension 5: Which role is given to argumentation?			
5.1- Teachers facilitate interactions through students within each team.	5.2- Teachers communicate each team's propositions to the whole class	5.3- Students are encouraged to consider their mates' assumptions, results, and conclusions.	5.4- Students are asked to justify their conclusions with respect to knowledge or evidence.
Dimension 6: What is the level of explanation of teacher's goals?			
6.1- Teachers communicate to the students their expectations for the current lesson.	6.2- Teachers make explicit what was taught during the inquiry session.	6.3- Students are asked to make explicit what they learned during the inquiry session.	6.4- Students rely on explicit knowledge and meta-knowledge which result from the inquiry session and will be useful within further situations and problems

Appendix 1: IBST six Dimensions model (September 2012 version)