Analysing the relationship between teacher's cognitions: differences and similarities in the teaching modes of two primary teachers

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The teacher's cognitions (goals, beliefs and knowledge) have a major role in their practice. Through the exteriorization of those cognitions – in action – teachers reveal their perspective and how they envisage the teaching process. To study these cognitions, the relations between them and the way they are exteriorized (type of communication, resources and pupils way of work) a model has been elaborated. For such teaching process I focused on the practice of two primary teachers and, from the analysis of that practice, using the model, it is possible to frame the teaching modes of each teacher. In this paper I will present, briefly, the modelling process and discuss the teachers cognitions (focusing in goals and beliefs) identified in the cluster of episodes presenting the content. I will make a first approach to the discussion of the similarities and differences in the teaching modes of the two teachers in that specific cluster.

Keywords: Teacher's cognitions; teaching modes; primary school teachers

Introduction

The way we teach has a direct relation with the way we envisage the teaching process and the role of *all* its components. It depends greatly from our own experience (professional and personal) and from the impact those experiences have, and the way we reflect upon them. When in practice, teachers "show"/exteriorize their perspectives about the teaching process through their actions. Those actions, associated with the way they express them and the type of communication they use with students, are the reflection of the teacher's beliefs, goals and professional knowledge (considered here as the teacher's cognitions).

To study these cognitions, the relationship between them and the way they are exteriorized (type of communication, resources and pupils way of work) a model has been elaborated. It is intended to simplify a very complex context such as teaching, and for that I have focused only in the components which I consider most influence it. The elaboration of this model (*cognitive*) is part of a research project, which aims to improve our understanding about which cognitions underlie teachers' actions in their practice in a mathematics class (in primary schools) and how they are related and change during time.

In this paper I will present briefly the modelling process and discuss the teachers' cognitions identified in a specific set of episodes of the practice of the two primary teachers mentioned earlier. Afterwards, I will discuss the similarities and differences in the teaching modes of the two participating teachers, in that specific set of episodes, in order to make a first attempt for the conceptualization of a theoretical "single case" build from the two teachers teaching modes.

Theoretical framework

The cognitive model used is an *evolution* of the one presented initially by Schoenfeld (1998a, 2000) and then adapted by Monteiro, Carrillo & Aguaded (2008) to Science teaching. In the model I focus on the teacher cognitions – beliefs, goals and knowledge –, on the students' way of work, teacher actions, type of mathematical communication, and the resources the teacher uses during practice. For the purpose of this paper, the teacher's actions should be identified with his/her performance in the classroom when dealing with their students' knowledge building.

Concerning beliefs I used an instrument gathered from Climent's (2005) work, where she presents a set of indicators of primary school teachers' beliefs, with respect to beliefs concerning methodology, mathematics, learning, and the roles of pupil and teacher.

With respect to the teachers' goals, like Schoenfeld (1998b), they are assumed as something that one aims to attain, and can be explicit or latent, and can likewise be pre-determined or emerge during the teaching activity. Each individual has the capacity to construct, adapt, model and remodel such goals in accordance with his or her own personal and professional development.

For the professional knowledge I have selected the categorization presented by Ball, Thames & Phelps (2008), which adapts Shulman's (1986) formulation of the components of professional knowledge. In this conceptualization, the authors divide the content knowledge and the pedagogical content knowledge, each in three dimensions. Content knowledge is considered, divided into common content knowledge (typical 'schoolboy' mathematics – know how to do), specialized content knowledge (needed only for teaching – know how to teach to do) and horizon knowledge. Concerning the pedagogical content knowledge they consider the knowledge of content and teaching, content and students and curricular knowledge.

The type of communication the teacher employs is in direct relation to the cognitions they hold, in that the way the teacher chooses to communicate reflects the way they view the teaching process. With different forms of communication, the actions are distinct and quite possibly show how the teachers view themselves. This idea has lead to the inclusion of the model of communication which the teacher uses. I use the classification of mathematical communication proposed by Brendefur & Frykholm (2000): unidirectional, contributive, reflexive and instructive, with some adaptations introduced by Carrillo, Climent, Gorgorió, Rojas & Prat (2008), namely concerning the idea of how the tasks presented influence the students understanding. Unidirectional communication is associated with a form of teaching in which the teacher takes the principal role, requiring the student to do no more than faithfully repeat what he or she has heard. With respect to contributive communication, the student is afforded some participation in the classroom discourse, although the interactions which take place are by and large of a corrective nature and do not go very deeply into the content. The key feature of reflexive communication is that the interactions between the teacher and students act as triggers for subsequent investigative work. Instructive communication is similar to reflexive communication, but aims also to shed light on the matter in hand, bringing about an integration of students' ideas – progress and/or difficulties – made explicit or intuited by the teacher or by the students themselves.

More information concerning this cognitive model, and some relations found between its dimensions, can be found in Ribeiro (2008) or Ribeiro, Monteiro & Carrillo (2009).

Research design

This paper is part of a wider research project concerning the professional development of two primary teachers, Maria and Ana, with 18 and 6 years of experience, respectively. These case studies are combined with a qualitative methodology. The data was gathered through audio and video recordings of a sequence of classes – centered on the teacher – and occurred in three different periods of the year, but always when they intended to introduce a new topic (in year 4 – students aged 8 or 9). Brief informational talks were also used before and after each lesson to gather lesson previews – lesson image – and to clarify some inferences. After transcribing the classes, and complementing the transcriptions with information gathered from the video (e.g. teacher actions and interactions with pupils), it was possible to elaborate on the teaching (cognitive) modes of each teacher. This process starts by identifying, in the lines of the transcription, the teachers' goal and which parameters of that specific goal are considered the triggering and terminating events. Between these events (corresponding to a set of transcription lines) can be identified all the remaining model components.

For the purpose of this paper I will refer in concrete to a cluster of episodes (presenting the content) from the practice of both teachers in the first phase. It corresponds to a sequence of tasks prepared by the teachers with the aim of introducing the thousandth. Here I will focus on the relations between the indicators of beliefs, communication type, resources and pupils way of work. The components of the teacher's knowledge and the others dimensions in the analysis will not be discussed.

Discussing the teaching modes of two primary teachers: relation between types of episodes, type of communication, form of work and resources

I will discuss the teaching practice of the two teachers concerning the episodes relating to the goal of presenting a content. Associated with these episodes there are a set of actions teachers do to achieve the specific goal they intend. Each cluster is formed by a certain set of episodes in which the main differences are the specific actions associated with each (each action has a set of beliefs and a specific goal associated). Thus, in this cluster, the central action is the one of presenting the content which is always associated with a reviewing or clarifying actions. The difference in the name of the episodes is also related to the resources used and that use is reflected in the teacher's action. Thus, when the teacher uses a certain resource there is an action associated to that resource which occurs (most of the time) independently of the type of communication used – and is related to the knowledge of content and teaching from the Ball's et al., (2008) conceptualization.

As previously mentioned, in these situations both teachers' main action is to present the content but, imbedded on it, they both make a revision. In the case of Maria's practice, this revision is associated with the actions of reviewing and clarifying the content (Ribeiro, 2009) and in Ana's practice it concerns only the reviewing action. These three actions are associated to a certain set of beliefs (indicators of beliefs) concerning the learning process and the teacher's role which are in direct relation with the type of mathematical communication used.

For Maria, when clarifying the content, the student must interact with the material and the teacher, the latter acting as mediator between the material and the

student. When presenting the content, they both assume that although learning may start from the observation of an inductive process, the true learning has to support itself in a deductive process. When reviewing the content they assume they must provide validation of the information brought out during the lesson, questioning students, whose replies lead to self-correction. In the first phase these actions occur only associated with a unidirectional or contributive communication, which means also that the teacher assumes for themselves the main role in the teaching-learning process.

These beliefs are exteriorized by the type of communication used and also, simultaneously, by the way pupils work, and the resources both teacher and pupils use. In this first phase Maria's presentation is based exclusively on unidirectional communication for the whole group and the resources used (overhead projector (OHP), board, drawing in the board and worksheet and board), and the association between them and the type of communication, are directly related to her beliefs (hers and pupils' role) concerning the teaching-learning process. Ana also presents the content to the whole group, simultaneously, but in her case, using a uni-directional and also a contributive communication. In this cluster of episodes (in the first phase) they both assume that when introducing a new content, students must hear and reproduce what the teacher says. Ana also uses as resources hands-on materials but their use occurs only to exemplify what she is saying – to give the pupils an idea of the number of parts the unit is divided and the size of such parts considering that specific unit (represented by a pizza or by the MAB).

The following table summarizes both teachers' practices viewed with the perspectives of the cognitive model, in the cluster presenting a content, concerning the relations between the cognitive model components – type of episode, type of communication, form of work and resources. These relations reflect the teacher's cognitions and their teaching modes in the episodes associated to the goal of presenting a content.

Maria			Ana	
Type of Communication and form of work	Resources		Type of Communication and form of work	Resources
In a unidirectional way, for the whole group	OHP	P r e s e n t i n g	In a unidirectional way, for the whole group	
	Board			
	Drawing in the board			
	Worksheet and board			
				Board and hands-on materials (by the teacher)
				Exercises book, board and worksheet
			Contributively for the whole group	Hands-on materials (by the teacher) (Pizza/MAB)
				Board and exercise book

Table 1 – Relation between episodes, type of communication, form of work and resources

The previous table gives us a better picture of the differences and similarities in the teaching modes of the two teachers in the episodes where the main goal is to present the content. Although they use different resources during their teaching practice, they show evidence that the main aim and role assumed by teacher and students, is quite similar (the teacher assumes the main role in the teaching process).

From the table we can also visualize that Maria uses only, two resources conjointly in one *cluster* of episodes. On the other hand, Ana adopts mainly the use of two or three different resources to allow students different perspectives and forms of representation about one same specific content. Besides the use of these different representations, she communicates unidirectionaly or contributively and, by that, although using a great variety of combinations the expected student's work and performance is quite similar (a passive position).

Some final comments

Both teachers assume the main role in the teaching process when presenting the content. The students play only a minor role, being required to do no more than faithfully repeat what the teacher says (in Maria's practice this is the only role the pupils can assume) or, if some participation in the classroom discourse is afforded, the interactions which take place are by and large of a corrective nature and do not go very deeply into the content. These beliefs have a direct relation and are exteriorized by their actions and type of communication used.

The resources they use – although different, and in different ways – assume the role of reinforcing the idea that the teacher is there to impart knowledge and pupils to hear and repeat what is said (as if the knowledge and understanding was something that you achieve by osmosis). The teaching practice of these two teachers in the situations under analysis can be identified as being associated with the traditional *delivery* model. Its use may be due to a lack of awareness of all the mathematical concepts involved and, the difficulty pupils have to assimilate it, or simply because this is the way teachers feel "safer" in teaching.

The use of the cognitive model allows to simplify the analysis of the teaching process and focus attention on the teacher's actions and cognitions, the way they relate to each other and how they influence the teaching process. Its use allows the identification of critical situations concerning the relations between the different factors being analysed and their impact in teaching. Through that identification, the discussion and reflections with teachers can became an initial contribution to improve teacher training in general.

Aiming to achieve a greater knowledge about each one of the model's dimensions, their role and potential in teaching, the next step will be to try to "*map out the territory*" of the teachers practice in all the episodes identified – focusing in all the model dimensions. Through that process ii is also expected to try to obtain not only a "single case" from the practice of these two teachers but also and more importantly a set of identified situations which can be used to improve teaching and the conceptualization of the teacher training programs. This new way of thinking about teacher training is essential considering all the changes currently taking place and the role that the continuous training programs are having in teacher training in general (I consider that due to the lack of specific initial training teachers have, ongoing training should be a very important role in their professional development).

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