

- Rochelle, J. (2000). Choosing and using video equipment for data collection. In: A. Kelly & R. Lech (Eds.), *Handbook of research design in mathematics and science education* (pp. 709-732). London: Lawrence Erlbaum Associates Publishers.
- Schoenfeld, A. H. (1998). On modeling teaching. *Issues in Education*, 4(1), 149-162.
- Serrazina, L., Canavarro, A., Guerreiro, A., Rocha, I., Portela, J. & Saramago, M. J. (2006). *Programa de Formação Contínua em Matemática para Professores do 1.º e 2.º Ciclos*. (Non published document).
- Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15 (2), 4-14.

THE IMPACT OF A PROFESSIONAL DEVELOPMENT PROGRAM IN TEACHER'S PRACTICE

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Abstract

Among the many ways in which a teacher can develop him/herself professionally can be found the participation in training programmes.

In this paper we will present some results of research which was intended to achieve a deeper understanding about the impact of a Program for Continuous Training in Mathematics for Portuguese Primary School Teachers on teachers' practices and professional development. With that aim, we focus on teachers' reflections concerning their participation in such a program and its influence in changing their practices.

1. Introduction

In the academic year 2005/2006 a Program for Continuous Training in Mathematics for Primary School Teachers (PCTM) was launched in Portugal with some unique characteristics – at least in this country. The main difference concerns the fact that teacher-trainers and teacher-trainees work collaboratively, having as a starting point the observation and discussion of the participating teachers' classes.

This program aims at an improvement in the teaching and learning of Mathematics as well as developing a more positive attitude towards this branch of knowledge. It has as a guiding principle the *valorisation of the teacher's professional development*. It aims at providing a site for joint experimentation and reflection so that one can ponder on the practices and use them to develop sustained knowledge, which takes into account the characteristics of the students whom it addresses.

It involves: conducting group training sessions (with about 8 teachers each) which take place every two weeks, for the development of curriculum proposals to be tried in the classroom; increasing the mathematical knowledge needed for

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their enforcement, and reflecting upon them; classroom supervision sessions that correspond (but not exclusively) to performing activities which put into practice the plans worked out in the joint sessions, with appropriate discussion; and one final plenary meeting for a final appraisal of the program.

Reflection is one of the most valued aspects in this training program. One of the goals it presents is, specifically, “*to favor the undertaking of curricular development experiences in Mathematics contemplating class planning, their management and reflection on the part of the teachers involved, supported by their peers and coaches*” (Serrazina *et al.*, 2006). Oral reflection is contemplated (with the teacher trainer and in group) as well as written and individual reflection on tasks to be included in the portfolio. During training several strategies are used to develop this capacity, such as: reading already performed reflections audio or video taped class observations, questioning and sharing of opinions/feelings and reflections.

Participant evaluation is undertaken through the elaboration of a portfolio, over the duration of the program (one academic year), to reflect the professional development resulting from the training. In the portfolio teachers should include at least the guide lines of two classes, along with posterior comments and reflections. It intends to show evidence of how a teacher and his/her students were progressing, recording lessons taught, assessments made,...

This paper is part of an exploratory study concerning the (effective) impact of the PCTM in teachers’ practice, and trying to reach a deeper understanding about it. We used two teachers who participated in this program for two years. Here we discuss some of the questions which guided that exploratory study. We aim to get a deeper understanding about the (effective) impact of the PCTM in the teacher’s (trainees) practice. With this aim, we will briefly present the PCTM and its characteristics, discussing teachers’ perspective, in terms of growing, concerning their participation in such a program and, to finish, we will discuss some crucial points, pointed out by teachers, as impacted in their practice.

2. Theoretical framework

We will discuss our understanding regarding reflection (in and about practice) as a “result” of task preparation (and discussion in the training sessions in the PCTM) and which lead, expectably, to the teacher’s professional development.

The teacher needs to update, enhance and deepen knowledge and skills which help him/her to face the needs of his/her professional life concerning Mathematics and the curriculum, didactics, students and him/herself. As a main element of his/her development it is up to the teacher to integrate theory and practice, to reflect upon his/her practice with the goal of improving it and to select the projects and training to undertake.

The PCTM, previously described, intends to allow teachers to prepare, discuss and reflect upon tasks. These tasks can assume different inputs and expected outputs, according to the perspective assumed by teachers and, in this case also the teacher's supervisors. They can be named according to the kind of mathematical thinking required to solve them, nevertheless they should promote the understanding of mathematical concepts, development of reasoning and communication, stimulate the establishment of connections between concepts and further relationships between mathematical ideas and other areas of mathematical concept comprehension and also between mathematical ideas and other areas (Serrazina *et al.*, 2006).

Any of these kinds of tasks intends to promote reflection (in teachers and, as a result, in students). The concept of reflection is widely used these days, mostly in proposals concerning teacher's training. This concept originated with Dewey (1933) for whom reflective teaching consists of "*active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends*" (p. 7). Donald Schön brings '*reflection*' into the centre of an understanding of what professionals do. The notions of reflection-in-action, and reflection-on-action were central to him (Schön, 1987). Reflection-in-action involves looking at our experiences, connecting with our feelings, and attending to our theories in use. Reflection-on-action is done later, we may write up recordings, talk things through with a supervisor and develop sets of questions and ideas about our activities and practice. In this context, we consider reflection as a means to improve practice, and, for that purpose, reflection must be supported by concrete situations from that same practice (the teacher's images, ideas, actions,...).

This reflection, when coupled with discussions focusing on the critical features identified in teachers' practices leads (at least intends to) to the teacher's professional development, not only for him/her in which the critical features were identified, but for all the members of the group. This is/was our perspective/mode of work in this PCTM.

3. Context and Method

This exploratory study involved two teachers (Ana and Afonso) who participated in the two years of the PCTM with us (researchers) as PCTM supervisors, in two very different and distant parts of the country. These teachers were chosen because they were the most experienced ones in each group (in terms of years of teaching). The data was gathered from semi-structured interviews and the teachers' portfolio – evaluation instrument of the PCTM.

According to the main goal of this exploratory study (to gain a deeper understanding of the (effective) impact of the PCTM in the participating teachers' practice), the semi-structured interviews had three major categories: (i) characterization of the PCTM; (ii) changes underwent in classroom practice; and

(iii) professional development sustainability – future training perspectives/needs. Thus, in interpreting data, we have considered those categories for analyzing both portfolios and semi-structured interviews and also evidences concerning teacher's perspectives during all the PCTM and its role/influence in their practices.

During data analysis, some points were common to both interviews and portfolios. So, when presenting the information we will only refer to which teacher it concerns, omitting if it is from one or both instruments.

4. Impact of the PCTM in teachers' practices

We will present the participating teachers', discuss their opinions and reflections concerning the PCTM, concretely concerning its influence in their own practice and what they have learned regarding professional knowledge (Ball et al., 2008).

Both participant teachers have more than 25 years experience. Ana denotes a great interest in learning new perspectives and approaches to teaching maths and that was one of the motives that made her participate in the PCTM. She was one of teachers who most participated in the group discussions, her reflections about her own knowledge (and/or lack of it) and her practice being seen by others elements of the group as inspired³². Afonso has been for a long time away from teaching (in a management post) and decided to participate in the PCTM mainly as a way to update his knowledge. They both consider of utmost relevance the participation in congresses, seminars, explicitly making the parallel with what they learn there and what they are supposed to teach to their students.

Characterization of the PCTM

In the following we refer to how Ana and Afonso characterize the Program. They both consider of extreme relevance the supervisors presence and the discussion/reflection component for the *good* development of such a program.

Afonso starts by characterizing the PCTM by referring to the training modality undertaken.

What is most relevant in this program is exactly the fact of not being a pre-formatted program, i.e., the whole freedom it presented. We (the trainees) together with you (teacher trainer) kept mapping our own way, our own path. I remember we discussed and defined the themes to work and everything in a systematic way. We worked the concepts, planned and then there was classroom supervision. This beyond all the reflection we undertook. It was a perfect circuit regarding training. Everything was constructed, all the learning we accomplished. Also the fact that the training took place during the whole academic year allowed for all the contents of the official curriculum to be scrutinized (Afonso)

³² This was recognized in the comments made by the group teachers in their final portfolios – evaluation instrument of the PCTM.

He considers that the most important aspect is the fact that there was no pre-determined order in the situations discussed (nevertheless the main contents were covered – as was supposed to occur). Trainees were able to make their own choices, and lived the same kind of experiences they are supposed (at least now) to allow their pupils to experience, allowing for a *perfect training circuit*.

Ana focuses her attention on our presence (trainers) in their class [as a way to help her improve her teaching], and in the gains she got from the group discussion and reflections.

The main positive aspects of this kind of program concern the fact that we have another person in class [PCTM trainer] to help us [in the supervised classes] and the discussions/reflections occurred relate to our own classes. (...) The discussions [of the classes of other colleagues] allow us to gain awareness about different situations that happened in other classes and prepare ourselves in case this happens in our own (Ana)

Afonso also refers to this dimension, and focuses on the kind of participation the trainer had in preparation of his classes (active, instead of passive)

It was a training essentially oriented towards classroom practice. Trainees were actively involved. We were dynamically involved; we were not simple spectators just receiving. We helped the building; we were participant actors (Afonso)

Changes underwent in classroom practice

In this aspect, both teachers focused on the role of *PCTM* trainers and reflections occurred as *the* important step for changes in their practice and their professional development process.

Ana stresses as the most important aspect of these changes, the awareness obtained from the discussion of her classes and of others', allowing the enrichment of her own practice.

Because of the PCTM I started to work division problems with my students and the last thing we were going to do was to learn the algorithm. I would rather make them understand different perspectives and ways to solve problems using their own strategies, and not limit them to the use of the algorithm. I also started to hear what they had to say during these problem solving activities and made them explain their strategies to the whole class (Ana)

She relates the changes in practice with the kind of tasks she proposes to pupils and the way she explores them, allowing an active role of students in the development of such activities.

For Afonso, the use of manipulative materials and the broadening of scope in problem solving strategies are the main aspects/topics presented/referred to as evidence for changes in his classroom practice

I haven't yet done everything I wanted to do, but I have that longing to do so. I have become more sensitive to mathematical issues, the importance of approaching Mathematics in a less abstract fashion, trying to make students do mathematics with pleasure, with enthusiasm. The adoption of a more motivating methodology such as the use of manipulative materials and problem solving. Although my way of facing mathematics already included problem solving (...) the broadening of strategies in problem solving was a new aspect (Afonso)

One of the main aspects also referred to by Afonso – just like Ana – concerning problem solving and the opportunities it presents to pupils, is the fact of not limiting them to the use of *the algorithm*³³, (*You can solve the problem in a number of ways. You can perform the algorithm, but you can also make pictures or schemes*) this being *the most visible influence in his daily practice*.

About mathematical knowledge acquired – content knowledge (CK) and pedagogical content knowledge (PCK) – the way of approaching them in the classroom is immediately associated. Both consider this increase of their knowledge, in all components (e.g. Ball, et. al., 2008), to be of supreme importance and a main point of the Program which leads to changes in practice.

The program brought me more mathematical knowledge. As I was away from pedagogical activity for a long time the program was useful to remind me of several subjects which lay dormant. But it is not enough to possess mathematical knowledge [CK], it is important to know how to work such knowledge with the students [PCK], and that was also a surplus value of the program. I specifically remember the study of Statistics, which involved a lot of work in group training sessions and I worked it a lot with my students in the classroom. (Afonso)

As for Ana, one of the situations she refers to as a jolt in her professional knowledge concerned the discussion regarding the difference between length and width.

I taught that length was always the horizontal side, and the discussions allowed me to clarify that mistake [CK] and to gain new perspectives of how to explore it with my pupils [PCK] (Ana)

Ana recognises the kind of learning she had in the *PCTM* and shows evidence of its importance concerning her pupils' learning (present or future).

About the reflection upon practice, Afonso lends special attention to the written reflection undertaken during training and which was used as a basis for the portfolio building. He considers this to be of most relevance because

Putting it on paper helps to systematize ideas and it is much easier to draw conclusions. Reflection brings a different broadening of the mind. It forces

³³ In Portugal, traditionally, teachers only use the operations to solve problems, being this the only way students know.

us to think better about what took place in the classroom, to pay more attention to student's reactions and to our own reactions. Quite often we do not reflect upon our work as we should (Afonso)

Professional development sustainability – Future training perspectives/needs

Also concerning their needs, both teachers focus explicitly on the need for being constantly updated. This update can be obtained from congresses and/or seminars in which they participate but these occasional participations must be complemented (or the contrary) by some kind of PCTM in schools, preferably with the same characteristics of this one (the characteristics they experienced³⁴).

Being a teacher is a job demanding constant updating. Any training must have the characteristics this had. I ran away a lot from many training sessions in which I was a simple spectator. It is important to keep up this training. I believe the creation of a work group would be interesting. Training involves sharing, through dialogue within the school itself, the grouping itself. If possible keeping this model would be important (Afonso)

Similarly, Ana considers this modality of the *PCTM* should continue in schools, and not only when the Board of Education decides to implement it. But she also recognizes the *difficulty of doing so in the context of her own school – among all the teachers (12) probably only 3 or 4 would be interested in doing so*. She reflects about her need for training, concerning the teaching process as a whole. Specifically with regard to maths, she refers that it would be of great help (to address her lack of knowledge) to discuss more Geometry and the elaboration of tasks/processes which allow teachers to integrate several mathematical contents – allowing their pupils (and themselves) to get a relational knowledge between the contents.

5. Final considerations

This kind of analysis of the teachers' reflections and comments about the Program allows us to deepen the degree of knowledge and understanding of how this program (and others with the same framework) impact on practice. The two teachers are considered experts in teaching by their peers even though they admit their lack of knowledge concerning certain contents (e.g. Geometry) and the ways to explore them with pupils. This attitude of admitting the fact of not knowing something, even having been being a teacher for so long, and their strength of character in wanting to improve their practice, even when they only have to work for just a few more years, made them face the PCTM as a learning opportunity – for them, and ultimately, for their students. The awareness obtained by the discussions of practices helps them to minimize the situations occurring in response to an unexpectedly arising event – content improvisations

³⁴ The PCTM is a National Program but each Institution of Higher Education can define the way in which they want to implement it.

(Ribeiro et al., 2009) –, allowing them to be more confident with their own practice. Similarly, if this kind of discussion is allowed with teachers in general, it may be a starting point for their awareness concerning their own way of facing practice.

As for us, PCTM trainers, we can argue that all the work and reflections in which we engaged during this experience led us, as teachers, to challenge our own practice in a variety of ways, which led to developing our own identities (as defined by Lerman, 2001) as trainers, teachers and researchers. Amongst other things, it has allowed us to amplify our understanding of the teachers' practice and where they would benefit from specific training. Their difficulties concerning some content topics (e.g. Geometry, Statistics) led us to an enrichment of our own knowledge, concerning both CK and PCK (as seen by Ball, et al., 2008), and also in terms of our understanding about teacher's reflection difficulties, potentialities and role in practice (theirs and ours).

Thus, participation in this program has allowed participants contact with several aspects which contributed to their professional development, namely the deepening of their didactical, mathematical and curricular knowledge, as well as the development of their reflecting capabilities. This study makes evident that continuous teachers' training must address their training needs, be based upon reflection about their teaching practices, and foresee the planning, giving concrete form and reflection on and about classroom tasks.

References

- Ball, D., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: what makes it special? *Journal of Teacher Education*, 59(5), 389-407.
- Dewey, J. (1933). *How we think*. Mineola, New York: Dover Publications, Inc.
- Lerman, S. (2001). A review of research perspectives on mathematics teacher education. In: F.-L. Lin & T. Cooney (Eds.), *Making sense of Mathematics Teacher Education* (pp. 33-52). Dordrecht, The Netherlands: Kluwer Academic Publishers.
- http://www.ucc.ie/Teaching_and_Learning/Scholar.doc (accessed 8 March 2007).
- Ribeiro, C. M., Monteiro, R. & Carrillo, J. (2009). *Professional knowledge in an improvisation episode: The importance of a cognitive model*. Paper presented at CERME 6, Lyon, France.
- Serrazina, L., Canavarro, A., Guerreiro, A., Rocha, I., Portela, J. & Saramago, M. J. (2006). *Programa de Formação Contínua em Matemática para Professores do 1.º e 2.º Ciclos*. (Non published document).
- Schön, D. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. San Francisco, CA: Jossey Bass.
- Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15 (2), 4-14.