THE EFFECT OF A TEACHER EDUCATION PROGRAM ON AFFECT: THE CASE OF TERESA AND PFCM

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Affective factors are strictly intertwined and have a strong influence on teachers’ professional practices. Literature underlines that primary teachers often have a negative attitude towards mathematics. For these reasons it is fundamental that professional development programs in primary mathematics teaching consider affective issues. In this study we analyze – describing the case study of Teresa, an experienced primary teacher with negative attitude towards mathematics - the effect of a Portuguese in-service program in mathematics and its teaching for primary teachers that includes, among its goals, the development of a positive attitude towards mathematics and its teaching.

INTRODUCTION AND THEORETICAL BACKGROUND

Many researchers have underlined the influence of several factors on teachers’ effectiveness: Shulman (1986) highlights the role of subject matter knowledge, pedagogical knowledge and pedagogical content knowledge, others scholars (for example Ernest, 1989) underline the role of affective factors. As Tsamir and Tirosh (2009) claim, mathematical subject knowledge, pedagogical knowledge and affective factors are strictly intertwined and have a strong influence on teachers’ professional practice. Therefore a professional development program in mathematics teaching limited to cognitive and pedagogical issues is “doomed to failure unless placed within an affective frame in which teachers have space to question mathematics and mathematics teaching” (Hodgen & Askew, 2006, p.41).

Literature shows that the common traits shared by many primary teachers (they are non specialist in mathematics and have often had negative experiences with mathematics as students) could generate uncertainty, low perceived self-efficacy as a teacher (Tschannen Moran et al., 1998), negative emotions as shame (Bibby, 2002) and anxiety (Hannula et al., 2007) and produce “deep seated beliefs [that] often run counter to contemporary research on what constitutes good practice” (Liljedahl, 2007, p.320).

Adapting the model proposed by Di Martino & Zan (2010) for attitude towards mathematics, we characterize attitude towards mathematics and its teaching by three strictly interconnected dimensions: emotional disposition towards mathematics and its teaching, vision of mathematics and its teaching, and perceived competence in teaching mathematics. According to this theoretical framework, primary teachers’ common traits could generate a negative attitude towards mathematics and its teaching.
For these reasons it appears to be very important, both for the teacher as a person and for the quality of mathematics teaching and learning, that education programs for primary teachers focus on the several aspects that characterize the affective side. Nevertheless there are few professional development programs focalised on affective aspects (above all for what concerns in-service primary teachers) and “there has been little theoretical or empirical research exploring teachers’ emotional relationship with mathematics” (Hodgen & Askew, 2007, p.470).

Reporting some major trends in teacher education research, Krainer and Goffree (1999) stress the increasing importance of “teaching stories”, seeing case studies as:

an outcome of teachers’ efforts to investigate into their own teaching (…) for them as an additional circle of reflection, for other colleagues and researchers as an insight into teachers’ challenges and change. (Krainer & Goffree, 1999, p.230)

The issue of our study is related to the theme of understanding, by means of small scale qualitative research, teachers’ opportunities to change their attitude towards mathematics.

We focus on PFCM (Programa de Formação Continua em Matemática): a Portuguese in-service primary teacher education program that includes among its goals the need to develop a positive attitude towards mathematics and its teaching in order to improve mathematical learning in primary school. Some studies on PFCM and its effects on teachers have been conducted by Portuguese researchers, above all teacher's educator directly involved in the program (e.g. Menezes, 2008; Canavarro & Rocha, 2010). These studies underline the good results of the program together with some obstacles (usually organizational difficulties).

Our study is different from the others mentioned above, mainly for two fundamental aspects: first, it is focused on teacher's change related with the affective domain of mathematics education; second, it offers an external point of view (the authors are not Portuguese and they are not involved in the PFCM program). This aspect can be of some relevance: most research on mathematics teacher education is conducted by teacher educators studying the teachers with whom they are working and “we do need more external research” (Adler et al., 2005, p. 371).

In this paper we will briefly describe the PFCM’s structure and, through the analysis of one case (Teresa), we will evaluate what elements of PFCM either hinder or promote the change in an experienced teacher with a deeply seated negative attitude towards mathematics.

**METHODOLOGY**

This paper is based on the analysis carried out for the first author’s doctoral thesis. Four teachers have been involved in the research, chosen according to two common features: their declared negative attitude towards mathematics and their feeling that, consequently to their involvement in PFCM, something changed in their attitude.
towards mathematics and its teaching. In this paper - due to the limited space - we only describe the case of Teresa. It seems to us particularly interesting because we recognized in Teresa all the common and critical traits highlighted by the literature on primary teachers; moreover her declared attitude towards mathematics and previous experiences with mathematics as a student are particularly negative. These elements, in our opinion, make of Teresa a real challenge for PFCM’s efficacy.

We used a qualitative and interpretive approach. This methodological choice follows our attention to the processes below the teacher’s change and not only to the certification of the possible change. We believe that qualitative analysis can highlight these processes. As Bruner (1986) states, narrative is the primary way in which we organize our own experience, trying to give it a meaning. Furthermore, the meanings given by teachers to their own professional development experience has an influence on their practice. For these reasons the main focus of the analysis has been on Teresa’s narratives.

Data collection was realized during the second year of Teresa's participation in the program. It included two observations of two-hours school lessons (two hours each) and a semi-structured interview a week after each observation. Each interview went on for about two hours. The first observation was in the first term, while the second observation took place in the third term. Moreover first author could see Teresa’s first-year portfolio: it is a 45-pages document including an introduction, her reflections upon two activities carried out in the first year and her conclusions.

**CONTEXT**

PFCM (Programa de Formação Continua em Matemática) is a national in-service program started in 2005, as a response by the Education Ministry to the Portuguese students' worrying results in mathematics emerging from PISA 2003 survey. The main aim of the program is to improve the quality of mathematics teaching in 1st-6th grade through teachers' professional development in mathematics and didactics. From 2009/2010 PFCM has also the goal of helping teacher to implement the new Mathematics Curriculum (Ponte et al., 2007). PFCM and the new Curriculum are oriented by a socio-constructivist model of teaching and learning processes, where mathematical knowledge is built in the classroom mainly through problem solving and “investigation” activities. As Ponte (2001, p.1) claims “there is a parallel between the activity of the research mathematician and the activity of the pupil in the classroom”. The author describes investigation activity in the classroom as follows:

“A mathematical investigation stresses mathematical processes such as searching regularities, formulating, testing, justifying and proving conjectures, reflecting, and generalizing. When one starts working on an investigation, the question and the conditions are usually not completely clear and making them more precise is the first part of the work. That is, investigations involve an essential phase of problem posing by the pupil—something that in problem solving is usually done by the teacher. However,
investigations go much beyond simple problem posing and involve testing conjectures, proving, and generalizing.” (Ponte, 2001, p.3)

The new Mathematics Curriculum and the PFCM are proposing a neat cut with “traditional methods” of Portuguese primary school. This was mainly based on knowledge transmission, with a central role of drilling exercises and learning by heart definitions or procedures. In order to make this revolution, teachers need to acquire new pedagogical and mathematical competences. As the national coordinators of the program recognize, primary teachers’ professional development needs to be based on the improvement of pedagogical content knowledge, reflective attitude about professional practice and, in many cases, on a change of “attitude” towards mathematics and its teaching.

PFCM’s goal is to promote professional development starting from teachers’ reflection on their own practice. Indeed, the main features of PFCM are its close relationship with teacher practice and school context and the long duration. The training program lasts two school years and it is composed by two typologies of sessions: (i) Group sessions (two per month, three hours each) involving 8-10 teachers and held in the school after the curricular school-time. In these sessions, teachers and tutor discuss about the mathematics curriculum, wondering about the content and pedagogical knowledge needed to plan lessons and about possible obstacles in their classes. They also discuss questions arising from supervision, (ii) Individual supervision sessions of classroom work (about ten hours per year), where the teacher, with the trainer's help, implements selected tasks explored in the previous whole-group working sessions.

The development of the teacher's reflective attitude is also promoted through the editing of a portfolio.

**TERESA’S STORY**

In the first meeting, Teresa (a very experienced teacher) introduces herself saying “I have never liked maths”. Her story with mathematics is a story of difficulties. In the first interview she tells that, when she was a pupil, she was terrified by multiplication table and counting:

Teresa: I did not like tables and I was afraid…I was afraid of counting money. I was terrified of counting money. I got stuck on it, I got stuck! I am not able to count money!

Maria: According to you why did you get stuck on counting?

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Teresa: My father had a grocery shop…At that time there were many coins. He knew that I did not like to count the coins and he obliged me to count and I failed! Then he beat me (she laughs).

The emotional charge of this story is clear. It is interesting and surprising, at the same time that, in Teresa’s view, this experience has not had any impact on her difficulties in mathematics. She strongly rejects Maria’s hypothesis about the relationship between her experiences at home and her attitude towards mathematics. She explains that, in her family, two brothers out of four have their father’s maths genes. Describing her father, she says that he “adored” maths and that he had an extraordinary intelligence in this field. She seems to suggest that if she were as gifted as her brothers she would not have been beaten.

Teresa tells about her aversion towards memorization (and towards all topics that she links to memorization like tables, numbers…) and, vice versa, her appreciation for visualization in mathematics. Her very few positive marks in mathematics as student (in grade 8) are linked to particular topics like geometry:

Teresa: When I got those marks, I do not know the reason. But I remember that I was able to see everything quickly! I discovered all. I don’t know…I adore geometry!

The discovery of visual strategies in mathematics represented a turning point for Teresa: in her experience as a student they were accepted only in few topics and contexts. Starting from the new approach to mathematics met in PFCM (based on the use of multiple problem solving strategies including visual ones, not limited to geometry) Teresa thinks back to her experience as a student. This reflection, together with the experience in PFCM, convinces her about the need, for students, to use different strategies in mathematics and to seek their preferred ones and, for teachers, to give prominence to all the different strategies used by the students.

In grade 10 Teresa chose a humanistic course of study and “turned away from mathematics”. Three years later, she enrolled in a university course necessary for becoming primary teachers in Portugal and during the first two years she took mathematics courses. She describes this experience with mathematics as very difficult but positive. Teresa was enthusiastic of her teacher:

Teresa: I had a wonderful mathematics teacher. Even now I love him, he is my life! (…) I had again good marks with him and I did not like maths at all!

In spite of this last positive experience as a student, Teresa seems to be still confined in the role of someone who does not like maths. In her long teaching experience (almost thirty years) Teresa had never been involved in significant mathematics development program before PFCM.

TERESA AND THE PFCM

In the first interview, Maria asks Teresa why she decided to enrol in PFCM.
Maria: Why did you decide to enrol in PFCM last year?

Teresa: First of all we are obliged to enrol in some teacher development program. Then I thought that I had to follow something new related with maths...I haven’t done mathematics for too long, I do not like mathematics and I think I have to learn something more because we have to start with the new Curriculum. So I thought that I had to enrol. And I like it very much.

Maria: Did you enjoy it?

Teresa: I enjoyed it. I liked my trainer very much, I think that he has been wonderful, he taught much. He has been excellent!

From this excerpt emerges that, although Teresa decided to enrol in a teacher development program for an extrinsic reason, it was nevertheless her need to be ready for starting with the new Curriculum that addressed her towards the PFCM. Moreover, Teresa underlines the role of the trainer in triggering her enthusiasm for the first year of the project. Afterwards she gives more details about what she had learned from her trainer, also observing him to put his suggestions into practice.

Teresa: F. taught us...taught me...if I noticed that then the others noticed too...simple and practical words: “look, look again, try to explain with your words, pay attention, reflect, how did you do this thing? Are you able to explain how you did that? Ah explain! Try to write it down”. Because many students are not motivated to write and explain what they know, what they have done (...) F. taught me this way to ask students to explain how they have done something. We used to order them: “not like this! Not like this!!” But this is not the right way to teach this thing! (…)

F.’s suggestions about the way to interact with students during maths lessons (“the simple and practical words”) and his behaviour in the classroom are related with a view of mathematics in which error is not the focus. Arguing skills and comparison between different strategies become the main points. This new way of viewing mathematics seems to cause a radical change not only in Teresa’s beliefs towards mathematics, but also in her emotions and attitude. It seems that now mathematics “is totally different” for her:

Teresa: I think that [mathematics] is difficult, I keep thinking that it is difficult, anyway I like it much more. I think that…it is totally different.

Maria: Why do you like it now and before you disliked it?

Teresa: Sure. Because...how can I explain that? Why do I like it much more now? Because there is not a unique way to do things!

At the beginning of the second year of the PFCM two significant events happened: Teresa was assigned another tutor and the new Curriculum started in its first
implementation. As the first interview shows, Teresa lives dramatically the change of tutor. She feels that the significant path started with F. is definitely interrupted:

Teresa: I need to learn much more about mathematics. Do you understand? Much more! It is what F. did with us: he taught maths.

Maria: Then do you need to continue this path?

Teresa: Exactly! Because, after all, we have done all on the surface. Do you understand? On the top! Now we need to go in depth!

She attributes that to the inexperience of J. (the new tutor): unlike F., J. is not a school teacher and Teresa thinks she cannot deeply understand teachers’ needs and difficulties. Moreover, the overlap of commitments linked to the start of the new Curriculum caused the lack of time for reading and studying in depth mathematical or teaching-related issues. According to Teresa, the previous year she positively faced the changes in her practice, because it was a gradual change and teachers had the time to both share and manage this change. Moreover, she recognizes some aspects of disorganization in the start of the new Curriculum, for instance there were no texts or handbooks ready for the new Curriculum. The work load, the uncertainties and the lack of an adequate support cause negative emotional reactions in Teresa and, according to her, in her colleagues. She claims: “we cry”!

The second interview is carried out in May, at the end of the second year of PFCM. The stress period has gone, Teresa is surely more relaxed and she shows a renewed enthusiasm towards the experience in PFCM. She is conscious that she changed her practice from the traditional way towards an inquiry oriented mathematics teaching. This change gave such unexpected results with students, that Teresa tells Maria with emphasis, underlying her happiness:

Teresa: Students from a school on the mountains getting A mark! I was admired! I was so happy! (...) I think that the few things made the last year have opened their minds and perspectives and they got A in maths!!!

She has not a definitive idea about the validity of her new method to teach maths:

Teresa: Perhaps this way to do maths is easier. Or rather it teaches to work better and then the students do everything more easily. I am not able to discover that! I need time to understand. Perhaps they understand more and if they understand they do better. Perhaps this new way makes it easier to understand.

She keeps attributing this success principally to the action of F.:

Teresa: He gave me a different perspective about mathematics, completely different. More practical, I do this in my classroom now. It is all a discovery! All, all, all! And I don’t know how I can be so ahead with mathematics now.

The enthusiasm of Teresa is not only justified by the good marks of her students but also by the changes in pupils’ attitude towards the mathematical activity:
Teresa: It is very nice that they [students] realize that one answers in one way, another in a different way, another in a further way...but all the ways are right! “teacher, I have done it different from you!” I find it funny!

Due to these results Teresa’s perceived self-efficacy as mathematics teacher grew:

Teresa: Now I think that I would be able to orient a group of teacher, do you understand? Help other colleagues! Now I feel that I have the capacities to do that! Now I know how to explain the new Curriculum.

She reports an episode in which other primary teachers recognized her as an expert in mathematics and she is aware that her beliefs about mathematics have changed:

Teresa: Some days ago a colleague told me: <Teresa, you that are learned in maths, explain that thing to me>. He said that and I thought I have never been learned in maths, they wouldn’t believe that I didn’t like maths! But it is true! Now I think that I view maths in another way and in another form.

This professional change makes Teresa more confident about possible results with pupils in the future. She is now convinced about her ability to obtain the expected goals of the new Curriculum. Teresa concludes the second interview showing her awareness that with PFCM and the implementation of the new curriculum she has started a path towards autonomy in teaching maths and she wants to continue it:

Teresa: This year has been an experience. Now we have to begin to get organized.

In this growth, Teresa changes also her consideration of the textbook: from the feeling of being discouraged without it, to the idea that the textbook is only the starting point to develop teaching ideas individually.

CONCLUSIONS

Teresa is a difficult case: she has a personal history with mathematics full of difficulties and her emotions towards mathematics are strongly negative; moreover, she is a very experienced teacher with very deep-seated beliefs about mathematics and its teaching. The analysis of her case shows that, despite these difficulties, at the end of the two years of PFCM Teresa, her emotions and beliefs have changed radically. It is true that the main reason to enrol in PFCM was extrinsic (the need for career progression), but this decision gives Teresa the chance to engage in an unexpectedly significant developmental path:

Teresa: Sometimes we leave for a journey and we don’t know why! But when we discover new things during the journey, we find new perspectives on life!

Teresa’s change happens as a consequence of the encounter with a “different mathematics”, introduced by the tutor, that Teresa implements both in the group sessions and in the classroom (the tutor in this phase represents a model and also a facilitator). The change in Teresa’s view of mathematics is relevant also because it elicits an emotional change: Teresa begins to appreciate mathematics (“now I like it
because I see that there are many ways to do the same thing”). In PFCM Teresa has had the possibility to develop a new idea of mathematics, to learn aspects of mathematics that she ignored and to appreciate a more open method to teach mathematics (related and consistent with her new view of mathematics). This possibility has originated a virtuous process in which Teresa develops the pleasure to do and teach math, increasing her perceived self-efficacy towards mathematics and its teaching. In this process Teresa changes her attitude towards mathematics and she is rewarded and also comforted by students’ reactions (and results) to her new way of teaching mathematics.

It is a process and, like all processes, on the one hand it is full of crossroads and on the other hand it needs time (we cannot expect to get radical changes without time expense). The structuring of PFCM (through the group sessions where the teacher can explain his/her doubts and the continuous support of the tutors) provided great help to Teresa for overcoming the crossroads she met; concerning the time variable, in our analyses we could notice how the second year was crucial to realize the change in Teresa's attitudes and practices (it is important to underline that PFCM is one of the few in-service teachers programs lasting for two years).

We are aware that our analysis is limited to a single case, nevertheless we think that this case has the strength of an existence theorem in mathematics: a radical change of in-service teachers’ attitude towards mathematics and its teaching is possible also when it appears to be very difficult to be realized.

Furthermore, as emerges from our analysis, the change we observed is due to PFCM's specific features, that provided the necessary conditions to overcome the teacher's difficulties, by paying attention to content, to teachers’ practice and to the affective side of teaching at the same time. We think that Teresa's case shed a light on the great potential of this teacher education model for the professional development of in-service teachers.

REFERENCES


