

A stylized sailboat with a yellow sail and a grey hull, sailing on blue waves. The sail is labeled with the Greek letter β and the hull with α . A small bird is flying above the sailboat.

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PRE-SERVICE PRIMARY TEACHERS' EMOTIONS: THE MATH-REDEMPTION PHENOMENON

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The relationship with mathematics of future primary teachers is very often built on negative experiences with mathematics as students and characterized by strong negative emotions towards mathematics. This phenomenon is alarming because of its consequences on teachers' development and practice. Nevertheless, many future primary teachers reveal a desire for "redeeming" themselves from negative past experiences in order to become "good mathematics teachers". In this perspective, we conducted a narrative study aimed at deepening the knowledge of this "math-redemption phenomenon", and trying to identify its roots and features.

INTRODUCTION AND THEORETICAL BACKGROUND

In her very famous book "Do you panic about maths?", Laurie Buxton (1981) describes how, for many pre and in service primary teachers, the relationship with mathematics is often built on several negative experiences with school mathematics and it is characterized by negative emotions. In particular, pre-service primary teachers' negative emotions towards mathematics are confirmed by more recent studies (Di Martino & Sabena, 2011). This phenomenon is worrisome because, on the one hand, emotions towards mathematics influence teachers' practice, and therefore strongly affect the quality of students' learning in mathematics (Hodgen & Askew, 2011). On the other hand, they can seriously interfere with pre-service primary teachers becoming good mathematics teachers (Hannula et. al, 2007). Teachers' emotions are a crucial factor that influence also teachers as decision-makers:

Teacher knowledge is located in 'the lived lives of teachers, in the values, beliefs, and deep convictions enacted in practice, in the social context that encloses such practices, and in the social relationship that enliven the teaching and learning encounter'. These values, beliefs and *emotions* come into play as teachers make decisions, act and reflect on the different purposes, methods and meanings of teaching. (Zembylas, 2005; p. 467, emphasis as in the original)

Nevertheless, there is not much literature about teachers' emotions: whereas research on teachers' beliefs has been extensive and subsumed into almost all areas of research on mathematics education, the study of teachers' affect has not (Philipp, 2007).

Moreover, the emotions evoked by mathematics are largely a product of the lived experience with mathematics as *students* (Brady and Brown, 2005), but:

limited research, however, was located that examined the relationship between pre-service teacher education students' experiences with formal mathematics instruction, and their future professional practice. Specifically, more needs to be known concerning the manner

in which past experiences at school may have influenced both attitudes towards the subject as well as confidence in teaching it. (Brady & Brown, *ibidem*, p. 37)

Within this framework, three years ago we began a study to investigate about primary pre-service teachers' emotions towards mathematics and their links with their past experiences (as math-students) and their future perspectives (i.e. the emotions evoked by the idea of having to teach mathematics in the future). The results of the study, based on an open-ended questionnaire, confirmed the connection between emotions towards mathematics and past experiences as math-students. Moreover they also highlighted that many future teachers, among those who declare strong negative past relationship with mathematics, express the desire to reconstruct a relation with mathematics (Coppola et al., to appear). This desire, that we call the *desire for math-redemption*, appears to be a very promising phenomenon for teacher education: it is the desire to face the "challenge" of teaching mathematics, starting from a personal reconstruction of the relationship with the discipline. As teacher educators, we have the chance of leveraging this desire, in order to break the chain connecting the negative past school experiences with the negative feelings towards mathematics of many primary pre-service teachers. Therefore, we have recently conducted a new study with the aim of deepening the knowledge of the math-redemption phenomenon. The study is guided by the following research question: what are the cognitive and emotional roots of the desire for math-redemption of future primary teachers? We use a narrative approach to trace these roots in future teachers' mathematical stories.

METHODOLOGY

Procedure and population. Our study developed through two phases:

i) The first phase involved a group of 90 future primary teachers, enrolled in the compulsory course on Mathematics and its Teaching of the University degree for primary school teachers of a relatively small Italian public University. In the first lesson of the course, we administrated the open-ended questionnaire developed in the previous study (Coppola et al., to appear). Respondents were asked to answer in anonymous way (choosing a nickname), within 45 minutes. The questionnaire is composed by 12 questions, investigating emotional disposition, beliefs and perceived competence in mathematics. In this paper, we focus primarily on the answers to the questions related to emotional disposition towards mathematics and towards the idea of having to teach it. They are: Q1: "Write 3 emotions you associate to the word *mathematics*" and Q2: "Which emotions do you feel in knowing that you will have to teach mathematics? Why?"

ii) In the second phase, we conducted 11 semi-structured interviews. This phase involved 11 volunteer students: 6 of them had participated to the first phase and, in answering to the questionnaire, had declared some negative emotions towards mathematics. The other 5 students had been enrolled in the course on Mathematics and its Teaching (and they had filled the same questionnaire in their first lesson of the course) two years before, when the course was not compulsory in order to obtain the

degree. So, they had chosen to follow the course, despite the declared problematic past relationship with mathematics.

The interviews were based on the explicitation interview method (Vermersch, 1994). This method is based on particular techniques for the formulations of the re-launchings (questions, reformulations, silences) aimed at facilitating and attending the a posteriori *verbalization* (in the sense of putting into words) of a particular experience. In our case, the initial hints were prepared on the basis of the analysis of the open-questionnaire used in the first phase. They regarded: an episode of the mathematical experience that the interviewee considered particularly significant, a mathematics teacher that has influenced (positively or negatively) the personal relationship with mathematics, the eventual turning points in this relationship, the idea of having to teach mathematics. Because of their nature, interviews had not a settled time: in our case, it varied in a range from 20 to 45 minutes. The interviews were audio-recorded and then fully transcribed.

Rationale. The choice of the research instruments is not neutral: the choice of the open-ended questionnaire reflects our conviction that the variety of possible answers coming from open questions is an irreplaceable value for the purpose of our study. According to Cohen et al. (2007, p. 249):

It is open-ended responses that might contain the ‘germs’ of information that otherwise might not have been caught in the questionnaire (...) An open-ended question can catch the authenticity, richness, depth of response, honesty and candor which are the hallmarks of qualitative data.

The data gathered by the questionnaire were analyzed through an inductive content analysis (Patton, 2002). In particular, for a first rough classification of emotions into positive/negative emotions, we referred to the theory of cognitive origin of emotions (Ortony et al., 1988), that describes emotions as “valenced reactions” to consequences of events, action of agents, or aspects of objects, and classify the reactions to events in being pleased and displeased, the reactions to agents in approving and disapproving, and those to objects in liking and disliking. These dichotomies permitted a first classification of emotions into positive and negative. On the other hand, we are aware that open questions too have their limitations: they are still one-way, when compared with interviews. Then, in line with Bruner (1990), that describes narrative as a strong means to interpret human actual thoughts, we completed our survey through the use of interviews. In particular, Kaasila (2007) has highlighted the potential of narrative interviews for the study of pre-service teachers’ emotions towards mathematics. Regarding the analysis of this kind of narrative data, Lieblich et al. (1998) recognize two main independent dimensions: holistic vs categorical and content vs form. The former refers to the chosen unit of analysis, which can be the narrative as a whole, or specific utterances singled out from the complete narrative; the latter refers to the traditional dichotomy made in literature between the content and the form of a narrative. Our approach is mainly content-categorical oriented, being considered particularly suitable to study a phenomenon common to a group of people (Kaasila, 2007).

RESULTS AND DISCUSSION

The analysis of the answers to the questionnaire confirms that mathematics evokes negative emotions in many primary pre-service teachers. Looking at the answers to Q1 “Write 3 emotions you associate to the word *mathematics*”, we find two alarming results: the 28,9% of the participants writes only negative emotions; three over four (the 75,5%) of the participants to our survey uses at least one of the following terms: *fear, anxiety, stress, distress, tension, anger, anguish, affliction, dread, boredom, panic, discouragement, depression, repulsion, revulsion, frustration, unease*. However, answering to the question Q2 (“Which emotions do you feel in knowing that you will have to teach mathematics? Why?”), the students show more positive emotions about their eventual future enterprise of teaching mathematics: the 43,3% declares positive emotions towards this eventuality, compared with 41,1% that declares negative feelings (10% does not provide an answer to this question, and 5,6% replies with mixed - positive/negative - emotions: for example fear and excitement). These data seem to be related to math-redemption, and this impression is confirmed by reading the motivations written by those respondents indicating *negative* emotions towards mathematics, and *positive* emotions towards the idea of having to teach it. For example, Shirly writes: “*Since I am a person more inclined towards humanities, seeing myself in the role of mathematics teacher is very gratifying*”; and Maggiolina: “*I’m convinced that using a good method, I will be able to get my pupils to love mathematics. I can get my redemption*”.

In Table 1 we report the percentages of Positive (P), Negative (N), Mixed (M) emotions evoked by the idea of having to teach mathematics in relation with the four groups identified by the answers to the item “Write 3 emotions you associate to the word *mathematics*” (NE_0, NE_1, NE_2, NE_3 indicate respectively the group of respondents that have indicated 0, 1, 2 or 3 negative emotions):

	P	N	M	No reply
NE_0	63,2%	15,8%	10,5%	10,5%
NE_1	53,6%	42,9%	3,5%	0%
NE_2	36,4%	40,9%	13,6%	9,1%
NE_3	11,1%	66,7%	16,7%	5,5%

Table 1: cross-analysis of answers to Q1 and Q2.

The quantitative cross-analysis summarized in Table 1 shows that a subgroup with positive emotions towards the idea of having to teach mathematics is present in all the NE groups. On the other hand, the different consistence of these subgroups within the whole groups seems to indicate that the strength for pursuing a math-redemption decreases dramatically when the emotions towards mathematics are too negative.

The narrative data, gained through the interviews, provide many cues to understand the differences between emotions towards mathematics and towards the idea of having to teach it, highlighting the math-redemption phenomenon. Content-categorical analysis of these data allows us to identify some features of the phenomenon. All the 11

respondents speak about their serious difficulties in the relationship with mathematics, and they identify a clear turning point in school-experience, a real crisis' moment:

Angela: During grade 12 I wanted to change school (...) It was a real crisis of rejection, during grade 12. Now I remember! Exactly a crisis of rejection (...) because I was not able to sustain the charge, especially for what concerns maths (...) And then I said to myself "I finish this year, and after that I don't want have nothing to do with math".

In these turning points, the role of math-teachers is always recognized as crucial. Almost all the narratives of the students describe one or more school episodes featuring a math teacher that is disrespectful of the students' needs, sometimes a teacher with whom it is impossible for the students to establish any relationship:

MariaTeresa: During grade 10 there was a change, I have had a teacher with which really, I was not able to built a relationship (...) and in that moment I have had... in other words like I was done, I was over mathematics.

Doriana: During high school I had an old school teacher, detached in the relationship (...) he used to write and write entire blackboards with numbers, and, when he arrived at the end, he used to delete the signs and start again.

This poor consideration for students is recognised as particularly problematic for those who have difficulties in mathematics:

Piurla: They explain a topic, a theorem, something. If you understood: good! If you did not understand something, it was you that did not understand! They did not use to face the question "why did he/she not understand?" or "perhaps I could try to explain that in a different way", No! That was 'The way'!

On the one hand, the firm awareness of this negative influence of the math teacher on their relationship with math elicits in the pre-service teachers the fear to do the same errors. So, fear becomes the emotion with which they approach the teaching of math:

Margot: [speaking about her first experience as math substitute teacher] I was afraid of not being able in teaching math. That is, I was afraid to make the same errors that my math teachers made with me.

On the other hand, however, the same awareness is one of the main motivations for trying the reconstruction of the relation with math, the germ of the math-redemption:

Margot: The incentive to restart with mathematics has been the motivation to be a good teacher.

Iperurania: It would be great if I had to teach math! Just for my past experience I would do something more. If I could teach math, I'd wake up in the morning with a lot of energy, because I want to transmit what has not been given to me, I don't want that my students think of mathematics as I thought of it!

From the interviews, it emerges that this motivation is shared among all the respondents: they show a strong desire to become a better teacher than their own teachers, and to spare their future students from *math-pain*. But, in some cases (2 over

11 of our respondents), a *feeling of uncontrollability* prevails: it seems impossible to imagine overcoming the difficulties *with* mathematics related to strong negative emotions towards mathematics, and to inadequate math knowledge. This feeling of uncontrollability affects the self-perception as mathematics teachers, and determines negative emotions also towards the idea of having to teach mathematics; hence it appears to preclude any possibilities for math-redemption:

La mente contorta: I associate non-positive emotions towards the idea of having to teach mathematics (...) just because I have had bad experiences during high school education, I don't know how cover my blanks!

Tania Bolena: I hope that I will never have to teach math. Sincerely, I don't like mathematics and then I don't know how I could spread passion for maths to my pupils. I already know that I could ruin them!

Vice versa, for all the other 9 cases, the *feeling of controllability* is the key-element for the math-redemption. These respondents express the conviction that, in order to become a good teacher, the reconstruction of the personal relation with mathematics is needed: it will be a hard challenge, but they will be able to win this challenge. This aspect appears particularly explicit in the words of the 6 students that have chosen the mathematics course when it was not compulsory:

Margot: During my first year at university, I could choose between physics and mathematics course. I had no problem with physics, it would have been the easiest way, but I thought "No, it is the time for facing with math, for understanding whether I'm able to get closer to mathematics or if me and maths are on separate rails".

Angela: It was a challenge that I wanted to do! I chose that one, despite my difficulties with maths (...) Thinking to teach mathematics troubles me to a certain extent, but now I am quiet because I have a different approach: before I used to think "no, I am not able" and I rejected to find a solution to the problems, now I gear up and I try to understand how to find a solution, because I believe that difficulties can be overcome.

Among the 9 narratives reporting a travel towards the math-redemption, it is possible to recognize some further interesting common features. All the narratives are full of emotional charge: *pain* is the label usually used to describe the experience as math students. This pain is also related to the awareness that the relationship with math has strongly influenced important choices in the life, sometimes even impeding the pursuing of some personal ambitions:

Margot: I gave up entering college of architecture because of math: what a pity!

From the narratives, it clearly emerges how school experience of the respondents, i.e. their past as math students, influences the process of redemption in terms of:

i) *motivations*: the desire of math-redemption is often linked with the will to take a sort of 'personal revenge' on teachers.

Angela: Surely I'm going against the image that my primary teachers had of me: yes, this is a little revenge!

Mathe: At the end of the middle school, despite the fact that I got the maximum mark, my teacher said to me “but I don’t suggest you to carry on with mathematics”: he should not have said to me this! Now, maybe, I will become a *mathematician*, and he will not know that!

ii) *emotions*: the pain experienced in the past makes the ongoing math-redemption process full of positive emotions.

Marika: Despite my past rough relationship with mathematics, now I succeed in having this cohesion with math: it is an incredible satisfaction!

iii) *possibility to become a good teacher*, taking care of students’ difficulties and being able to understand them, since they personally experienced those difficulties.

MariaTeresa: it is possible to learn a lot of things: above all, from our past negative experiences.

Mathe: It is just because I felt this hostility towards mathematics as a student that I believe to have those motivations and also that experience useful to understand where pupils could run into problems, or feel hostility.

CONCLUSIONS

The research carried out for several years has confirmed the worrisome spread, among future primary teachers, of strong negative emotions towards mathematics. Nevertheless, it has also highlighted a very interesting phenomenon: what we have called the *desire for math-redemption*. Through the analysis of the narratives, we have outlined some typical features of this meaningful phenomenon: the pain during the experience at school; the key-role of a teacher that constitutes a sort of negative model (the narrator recognizes in this negative model what he/she does not want to become); the need of glimpsing the possibility that the reconstruction of the relationship with mathematics succeeds; and, finally, the deep (positive) consequences on the emotional disposition and on the self-perception of glimpsing this possibility. As teacher educators, we cannot ignore these features, in order to appeal to the desire for a math-redemption and to support future primary teachers in the challenge of reconstructing their relationship with mathematics. Our role as teacher educators is fundamental in the whole path of a math-redemption: first, in spurring future teachers to consider the idea of taking on this challenge, in creating propitious conditions for the overcoming of feelings of uncontrollability, and in persuading the future teacher that s/he can reconstruct a positive relationship with mathematics. The support of teachers’ educators is crucial also throughout the math-redemption process. In fact, being a “recovery” process, math-redemption is emotionally hard, as expressed by Chicca: “*the process of recovering my relationship with mathematics has been very hard from an emotionally point of view*”. The collected narratives show that, because of negative past experiences with mathematics, who decides to face this challenge proceeds with caution. These future teachers, above all at the beginning of this path, feel insecure and they need some help. With regard to this aspect, it is very significant the metaphor used by Margot: “*During the university degree, when I decided to get back into the game with math, I approached it very cautiously, just like children that are learning to walk*”.

Staying in the metaphor, as teachers' educators we have to motivate future teachers to take the first steps, as well as to encourage them after the unavoidable falls, guiding them with the hand, in order to make future teachers as confident as to decide to leave the hand and to walk alone.

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