INVESTIGATING AND WRITING IN THE PROFESSIONAL DEVELOPMENT OF MATHEMATICS TEACHER

Maria Teresa Menezes Freitas (FAMAT/UFU) - Brazil

Dario Fiorentini (FE/Unicamp) - Brazil

Abstract

This article describes and analyzes the role and the contributions of investigation and discursive writing in the professional development of mathematics teacher. This paper is based on two studies, both developed in Campinas State University (Brazil) and related to contributions from two subjects of a preservice program for mathematics teacher education – one, concerning mathematical content knowledge (Geometry) of future teachers and the other concerning teacher's didactic-pedagogical and curricular knowledge (Mathematics Teaching Practice and Teachers' Supervised Training). In both subjects, reflective and discursive writing about mathematics teaching and mini-research projects were developed. Besides dealing with this theoretically with this perspective in teacher's education, this study considers the narrative inquiry as a methodology to investigate the teacher's professional development. The narrative of professional development of one of the investigated teacher students – who attended both courses – has shown that writing and investigation has helped to better understand the complexity of school practices and of the process of becoming a mathematics teacher.

Introduction

The purpose of this paper is to describe and analyze the role and the contributions of both investigation and discursive writing in the mathematics teacher education. After theoretically discussing this perspective in teacher's education, we describe the narrative inquiry (Clandinin & Connelly, 2000), which represents a methodological alternative to investigate the teacher's education process. We also present the narrative development of a teacher-student that was observed for approximately three years, a period, during which, he became a teacher.

For this article, we counted on two studies, both developed at Unicamp (Fiorentini, 2004 and Freitas, 2006). The latter concerns the subject "Plane Geometry and Geometric Constructions", which is located at the Mathematics Department of the Mathematics, Statistics and Scientific Computing Institute (IMECC), and focussed on the mathematic content knowledge of the future teacher. The first study is related to the subject "Mathematics Teaching Practice and Teachers' Supervised Training" (Teaching Practice) devoloped under responsibility of the Teaching Methodology Department of the Faculty of Education (FE).

Investigation and the writing in teacher education

Didactic-pedagogical subjects have been concerned with the educative potential of discursive writing and investigation, especially when these procedures use and explore written registers of teacher's trainees (Freitas, 2000; Fiorentini, 2004).

Mathematics teacher education courses still maintain a teaching practice that values orality, explanation, repetition in long lists of exercises and distribution of a systematic, formalized and already built knowledge. Thus, the student doesn't reach this knowledge by doing explorations, inquiries or readings. When writing appears in this context it is usually technical, formal and without problematizing the mathematical knowledge. This way of using and exploring writing in the mathematics teacher's education does not contribute to his professional development.

In face of this problem, we were motivated to find out what happens during the future teacher's education, when mathematics subjects also begin to privilege a process of reflective writing. Our proposal is to show that the intentional exploration of reading, writing and researching in the process of teaching and learning mathematics is a potential way to expand the future teachers' ability to understand and reflect about mathematic activity in the classroom, promoting, this way, their personal and professional constitution.

According to Larrosa (1999), during the education process, the most important issue is not what the student learns, but the intimate relation that he establishes with the subject in study. In that sense, when the student deepens his studies in themes in which he is interested and which respond to his expectations and possibilities, he is not reduce to a simple object of education: he becomes, at the same time, a product and an agent of history and of his own intellectual and human development process (Fiorentini, 2004).

This conception of education, as well as the concept of experience in Larrosa (1998) and in Fontana (2002), seems to put in check the mathematics teaching processes that privilege the technical and formal reading-writing in mathematics and the one way access to knowledge – that is, the one provided by the teacher. Based on this conception, in order to obtain a genuine formative experience, mathematics teaching should contemplate an exploratory, communicative and inter-subjective practice, privileging knowledge search and production of meaning about what is learned and taught.

Considering the possibility of the contribution of research and discursive writing in a mathematics teacher education course, we put ourselves in a position of curious investigators who are instigated to understand the educative potentialities which can be reached by the use of various ways of communication, specially the writing one,.

The practice of investigating and writing in the courses

On the one hand, in the Teaching Practice course, at Unicamp, the investigating and writing activities are concerned, firstly, to the pedagogic practice of the other – generally an experienced teacher that collaborates as a tutor or supervisor of a teacher training – and, secondly, to the trainee's own incial teaching practice. Usually, the day-to-day school study was carried out by pairs of students and developed from ethnographic observations in classes – registered in diaries –, which were read, analyzed and discussed by them and their colleagues of the Teaching Practice discipline.

On the other hand, the proposal of the "Plane Geometry and Geometric Construction" subject was to integrate geometry and language and to privilege activities in which the students could write their thinkings and ideas. Freitas's (2006) research could count on the interest of Professor Sandra, responsible for that curricular subject, in developing discursive writing activities, in order to produce meaning for the mathematics contents explored in classroom.

In this subject, the students usually had to develop some activities at the computer that would necessarily have to culminate in a written production with pencil and paper handed to the professor at the end of each class. The material requested would change, according to the theme and necessity of the activity. Some of them were: the route the geometric construction; the demonstration of some statement; responses to some proposed questions; letters to an imaginary person (uncle or aunt) with no mathematics ability, explaining how the student had understood some construction, concepts or theorems.

Methodological considerations: *the narrative inquiry*

In order to describe and interpret the real contributions of those subjects in the professional development of a future teacher, we felt the necessity to establish, not only a synchronic analysis, but also a diachronic investigative movement, that is, we would look for traces of those subjects repercussions in the subsequent years, specially when those students

would initiate their teaching practice in schools. We needed, therefore, a qualitative and interpretative approach that could respond to this demand and we found it in the narrative inquiry proposed by Clandinin and Connelly (2000).

In the *narrative inquiry*, the participant shares with the researcher his personal and professional stories, which were related to the actions or to the activities that they would have accomplished, providing, this way, information and relevant traces of his professional development process along the time. As mentioned above, It's important to point out that in Freitas's (2006) research, in different moments and contexts, different aspects have propitiated many interactions: the interest of the professor responsible for the subject; the approach between the professor and the researcher - preserving an ethical position suitable to the research proposal – in an atmosphere of the respect, friendship, complicity and admiration.

The narrative inquiry represents, to Clandinin and Connelly (2000), a way of giving sense to experience as well as understanding. So, this kind of research assumes a tri-dimensional space which is constituted by the following dimensions: the first dimension is the "temporality", which involves past, present and future; the second one, would correspond to "personal and social" interactions; and the third one, to "place" (situation/position), the scenery where the story to be narrated happens.

This tri-dimensional metaphor of the narrative inquiry, created by Clandinin and Connely, presents a similarity with the Bakhtin's (1988) notion of *chronotope*. The term *chronotope* – literally, "time-space" was created by Bakhtin from the Einstein's *Theory of Relativity*, in order to express the inseparability between time and space– considering time the fourth dimension of space. In the narrative inquiry, the interdependence between "time" and "space" is essential to comprehension of the knowledge coming from experience.

This way, based on Clandinin and Connelly (2000) and on Larrosa (1999), we have tried to follow the development process of each participant and to be part of his/her movement, letting us flow along his/her course. In the context of this research, the narrative becomes, on the one hand, the object of study, because the narrated stories became the focus of our analysis and, on the other hand, the method, due to the fact that it would be through the narrative we would be exposing the analysis and turning public the interpretations and meanings of the investigated experience. We have followed the students of the Geometry course during the first semester of

2003 and we selected four protagonists of the class to revive and tell their stories in different moments of time, through autobiography (produced in the Teaching Practice course), interviews, virtual and live conversations. In order to follow their personal and professional development, we had to organize the field work texts and perform repeating readings of these records to construct meanings of. We made contacts by e-mail; interviews (E_1, E_2, E_3); and casual meetings during the two subsequent years (2004 and 2005).

For this paper, we will just narrate, below, the professional development trajectory of Frank Fitch, one of those four protagonists. We tried to capture and narrate this development movement, by interweaving voices that helped us to undestand the complexity inherent to the constitution of his subjectivity and of his future as a researcher-educator in the Mathematics Education field.

The narrative of professional development of Frank Fitch

Frank's wish to be a teacher comes from his childhood. The existence of teachers in his family (fathers and aunts) and the suggestion to reflect upon his choice, coming from some of his teachers, made Frank choose the Mathematics Education Course: *I have embraced Mathematics and I wanted to be admitted at Unicamp, because of the influence of some teachers. [...]* (Autobiography, Teaching Practice, 2003). When he began to study Geometry at Unicamp, in 2003, he established links with different contexts along his development path and identified discursive writing as something "new" and interesting: *The writing work was the major novelty for me; [...] I could develop a real research project… and not just deliver another work.* (E_1).

In other moments, Frank evaluates writing as a kind of analysis and an instigating element for thinking. He also underlies the indissociability practices of writing and analysis: *[...] when we were writing, we have to analyze a lot and, sometimes, we kept making demonstrations too, but without using formal criteria. [...] We had to think a lot. I have thought a lot.* (E_1).

In 2003, Frank was also attending a Teaching Practice course. He developed a research project about mathematic investigations in the 8th grade, and became aware of and interested in other possibilities of producing senses for learning and teaching: *Reasoning can be visualized in other ways and […] I think it is possible to teach a content in a more meaningful way to the learner.* (E_1).

The work that Frank has developed in the Geometry couse – combined with his other interactions, specially in the Teaching Practice course – stimulated his reflections regarding the relation between theory and practice and it was meaningful to him, in spite of the difficulties in his first contact with the *Tabulae* software*: "Maybe it was one of the few opportunities I had, in which I could really link this course and this very institution with practice"* (E_1).

Technological resources, combined with the mathematics subject learning, seem to have given a distinguished status to his education. In the end of the semester, the proposal of a seminar in Geometry was important to establish the necessary links to his professional development. Talking with colleagues, with himself and with the teacher, made him feel somehow like a teacher. So, he started to rethink teaching and to reconsider his conceptions: *"I've changed even the way of thinking and facing teaching, after that"*.

One year after finishing the Geometry and Teaching Practice courses, other learnings were added to the initial ones, building a complex web of multiple relations, in which *mathematic investigations* became prominent. Actually, Frank's growth is also a result from his participation in a collaborative group of teachers of mathematics (Saturday Group), a group that analyzes, researches and writes about mathematics teaching practices at school. This way, those learnings, which were inicially acquired in both courses, served as a base for continuin to grow as teacher. So, he started to assume himself as a teacher in a continuous process of development and as a researcher of his professional practice.

Although he finds difficult to be a teacher and a researcher at same time, he recognizes that discursive writing has been an indispensable factor for his professional development and an important resource to improve his teaching practice and the mathematical learning of his students.

In synthesis, the courses of Geometry and Teaching Practice have shown him the possibility of a non-exclusive symbolic and technical writing and also have instigated theoretical and practical reflections on the process of learning and teaching Mathematics mediated by writing.

The meta-cognitive potential that the writing provides is brought out by Frank Fitch in a peculiar way: *Reflection is improved by writing… So, when you write, you reflect and, when you read what you wrote, you "re-reflect"* (E_2). In this case, writing represents a strategy that

provides meta-cognition, as it involves “thinking of thinking” and, also, Frank’s ability to control his process of knowing, when he investigated and wrote about mathematics teaching practice.

In a reflective movement of comings and goings, Frank reveals an important teaching knowledge and assumes that each reality demands a methodology that mus be constructed by the teacher. He explains, then, the necessity of constructing himself continually: *And, so, what the teacher has to do is to… He needs to give the best of himself, mobilizing multiple ways of explaining [...] and this I learned with the experience of writing that I had at in the University preservice course* (E_3).

In synthesis, Frank’s professional development seems to have been supported and strengthened by a preservice education developed under the perspective of professional development, which was mediated by investigating mathematics teaching practice, through readings and writings about the process of teaching and learning mathematics and through reflection and interlocution with his colleagues.

Some conclusions

The narrative of professional development of Frank Fitch has evidenced important aspects of the presence of discursive writing in his personal and professional growth. This presence appears in several contexts along Frank’s education process: in his preservice education; in his discursive and reflective writing practices in the mathematics learning-teaching process in Geometry and on mathematics Teaching Practice. In the Teaching Practice course, the discursive writing helped to improve his perception and his understanding of the complexity of school practices and of his process of becoming a teacher in this context. However, the Geometry course, associated to the use of information and communication technologies and to the development of projects, have provided meta-cognitive processes about mathematics learning and brought out other meanings to this subject – its concepts and processes -, especially when the interlocutors had wasn’t very familiar with formal mathematical language.

Besides, it became evident that educative experience, with discursive writing about mathematical content, in a teachers’ preservice course, has influenced the teachers’ future practice, because they have also begun to explore it with students. From this experience with his estudents, Frank Fitch developed a reflective and investigative stance about his own practice,

because the students' writing led him to realize their difficulties and their points of view about mathematics teaching.

Frank‘s narrative reveals a strong professional development during his preservice course of mathematics teachers education, which is characterized by the distinguished presence of the reflective writing and investigation on the pedagogic practice in mathematics. During this trajectory, he has (re) constructed some concepts and images about mathematics and its teaching. Furthermore, in his first years as a school teacher, he also promoted an innovative and trasnforming way of teaching mathematics. His participation in a collaborative group of teachers (Saturday Group) and the presentation of his reports in congresses have revealed a teacher-researcher who contributes to the development of teachingculture and its professional field.

References

Bakhtin, M.(1988). *The Dialogic Imagination.* Austin: University of Texas Press.

Clandinin, D. J.; Connelly, F. M. (2000). *Narrative Inquiry:* experience and story in qualitative research. San Francisco: Jossey-Bass Publishers.

Fiorentini, D. (2004). A Didática e a Prática de Ensino mediadas pela investigação sobre a prática. In Romanowski, J.; MARTINS, P. L. O.; Junqueira, S. R.A. (Orgs.). *Conhecimento Local e Conhecimento Universal:* pesquisa, didática e ação docente. Curitiba: Champagnat, p. 243-157.

Fontana, R. A. C. (2002). Exercícios de aprender: os modos de ver, dos modos de ler e de dizer por escrito o ofício de professor/a nas experiências de formação. In: XI ENDIPE, Goiânia. *Anais...* 1 CD_ROM, 12p.

Freitas, M.T.M. (2000). *Estágio Curricular em Matemática na Perspectiva de Extensão Universitária:* estudo de uma experiência na UFU. 2000. 165f. Dissertação (Mestrado em Educação) – Faculdade de Educação, Universidade Federal de Uberlândia.

_____ (2006). *A Escrita no Processo de Formação Continua do Professor de Matemática.* 300p. Tese (Doutorado em Educação: Educação Matemática) FE/Unicamp. Campinas, SP.

Larrosa J. (1998). *La experiencia de la lectura:* estudios sobre literatura y formación. Barcelona: Laertes.

_____. (1999). *Pedagogia Profana:* danças, piruetas e mascarada. 4. Ed. Belo Horizonte: Autêntica.