

## ARTICLE

## TRAJECTORIES OF MATHEMATICS TEACHER EDUCATION IN DISTANCE COURSES: AMONG KNOWLEDGE, EXPERIENCES AND NARRATIVES

DIVA SOUZA SILVA<sup>1\*</sup>ORCID: <https://orcid.org/0000-0002-9358-3828>JUSSARA DE LOIOLA ARAÚJO<sup>1\*\*</sup>ORCID: <https://orcid.org/0000-0002-9156-2417>

**ABSTRACT:** This paper presents results of a research that had as goal to narrate and analyse, in a critical perspective, the experience of teachers' distance education in Mathematics, a situation in which the knowledge from teaching practice and the one acquired in higher education met. At the time, the student-teachers, who were subjects of the research, were already Mathematics teacher in Basic Education and, at the same time, pursued an undergraduate degree in teaching with a focus on Mathematics at the Open University of Brazil (UAB). The theoretical dialogue proposed here comprehend Mathematics teacher education, the knowledge mobilized in the teaching constitution and the formative path through distance learning. The investigation followed a qualitative approach and a research method called 'narrative research', inspired by Clandinin and Connelly (2000) and Bolivar (2002). The empirical material involved questionnaires, interviews, training memories and observations of the subjects' educational path. The meanings that they gave to their distance education, such as the search to 'presentify absences', in addition to the theoretical legitimization of elements treated in teaching, the certification itself, tensions and disagreements are some of the considerations found in this research.

**Keywords:** Mathematics Teacher Education. Mathematics Education. Teachers knowledge. Narratives. Praxis.

## TRAJETÓRIAS DE FORMAÇÃO DE PROFESSORES DE MATEMÁTICA A DISTÂNCIA: ENTRE SABERES, EXPERIÊNCIAS E NARRATIVAS

**RESUMO:** O presente artigo apresenta resultados da pesquisa cujo objetivo foi narrar e analisar, numa perspectiva crítica, a experiência da constituição

<sup>1</sup>Federal University of Uberlândia, Uberlândia, MG, Brasil.

<sup>11</sup> Federal University of Minas Gerais, Belo Horizonte, MG, Brasil.

\* PhD in Education from the Federal University of Minas Gerais (UFMG). Professor, Federal University of Uberlândia (UFU). E-mail: <diva@ufu.br > .

\*\* PhD in Mathematics Education, State University of São Paulo Júlio de Mesquita Filho / UNESP / Rio Claro. Professor, Federal University of Minas Gerais (UFMG). E-mail: <jussara@mat.ufmg.br > .

docente em Matemática, de alunos-professores, em um curso a distância, quando os saberes relativos à prática docente e à formação superior se encontravam. Os sujeitos exerciam a docência em Matemática na Educação Básica e cursavam a Licenciatura pela Universidade Aberta do Brasil. O diálogo teórico empreendeu campos da formação de professores de Matemática, dos saberes docentes mobilizados nessa constituição e o percurso formativo por meio da EaD. O caminho investigativo seguiu pela abordagem qualitativa e pela “investigação narrativa”, inspirado em Clandinin e Connelly (2000) e Bolívar (2002). O material empírico envolveu questionários, entrevistas, memorial de formação e observações da trajetória desses sujeitos em formação. Os sentidos que conferiram à sua formação, como a busca de ‘presentificar ausências’, a legitimação teórica de elementos tratados no ensino, a própria certificação na formação, tensões e desencontros, são algumas das considerações da pesquisa.

**Palavras-chave:** Formação de Professores de Matemática. Educação Matemática. Saberes Docentes. Narrativas. Praxis.

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## PRESENTATION

In-service teacher education is a reality in the Brazilian educational scenario. According to Torres (1996), numerous teachers working in the classroom, in the exercise of their profession, have not been provided with specific education, that is, they do not own a degree in teaching. When teachers do own a bachelor's degree, they are frequently not qualified for teaching in their respective fields. On the other hand, the article 87, item IV, paragraph 4th of the National Educational Bases and Guidelines Law - LDB 9394/96 (BRASIL, 1996) states that “until the end of the Decade of Education, only qualified teachers with a higher education degree or those who received in-service training will be admitted”. As a result, both government actions to expand the number of training courses and the demand for qualification by in-service teachers have increased during that period.

The understanding of the law and its various interpretations have contributed to a considerable increase in the number of teacher education courses on the grounds that untrained and unqualified teachers were no longer able to carry on their professional activity. This also encouraged the creation and approval of distance learning courses. Various Brazilian regions gained access to higher education courses through face-to-face support centers.

The research presented here has been carried out in this context. As a response to the policy, one of the courses offered was

teaching with a focus on Mathematics by the Open University of Brazil<sup>1</sup> (UAB). For the present research, we have followed teacher-students<sup>2</sup> who already worked as professional teachers in their distance education with a focus on Mathematics teaching. The institution was offering a Mathematics course for teachers for the first time in some cities in the state of Minas Gerais.

Considering the subjects' search for training in a critical approach, this research had the purpose of narrating and analyzing the experience of the teachers in their distance learning Mathematics course, on the assumption that the knowledge gained from teaching practice and the one offered by higher education would clash.

As the natural landscape of investigation, we have considered a distance learning course that encompassed various levels of interaction, the main one being online. The subjects received face-to-face tutoring in support centers, in addition to participating in study groups (in person and online) and videoconferences with teachers from the institution's headquarters. Online interaction took place on the distance education platform Moodle,<sup>3</sup> through forums, messages and activities. The relationship between students and instructors was thus virtual. But what does it mean to consider a virtual space a natural landscape of investigation? As Borba and Araújo (2012) point out, this is a question that deserves discussion. The authors affirm that the transformations occurring in the Mathematics education field as a result of the use of new technologies, particularly those related to distance learning, require new reflections on methodological issues. Lincoln and Guba (1985) argue that a research carried out in a natural context considers subjects to be part of this scenario, and they cannot be separated from it. The interaction between research and researcher then sets the plot in motion. In the present case, the natural environment of which the subjects were part had a strong virtual component. We considered it as it is: the online education environment of the teacher-students who were chosen to be subjects of this research.

The research methodology went through the steps of qualitative research, also involving an interpretative approach, which sought to capture the training experience of the subjects. In an attempt to capture their experience, we opted for the methodology of narrative research, assumed as a way of understanding the experience (CLANDININ; CONNELLY, 2000). One characteristic of narrative research is knowing the subjects and their stories, on which the researcher builds narratives using different data collection instruments. In this case, it included a critical approach to distance education as well.

As *locus* to our investigation, we have chosen two face-to-face support centers of teaching courses with a focus on Mathematics, in two different cities (200 km distant from each other). The choice was based on the openness shown by the course coordination. The subjects were initially approached with a questionnaire that covered their process of entry in the course and other aspects, such as their professional experience teaching Mathematics. This is justified by the fact that this was one of the focuses of their continuing education and one of the objectives of the present research. With an average of thirty potential subjects in each city, sixty questionnaires were applied, and twenty were actually answered. From these, six people already taught Mathematics when they entered the course. On the next stage of interviews, these six were invited to participate in the research, three from each city. Initially, all of them agreed to the Free and Informed Consent Form. Later, on a second stage of the research, which involved narratives, three of the subjects moved away from the project for various reasons, like their withdrawal from the course and time constraints. These were the criteria for the assembling of profiles with which we have worked.

This investigation is based on the narratives of the stories and experiences of Lincoln, Rosângela and Fernanda, students of a distance teaching course with a focus on Mathematics who already had professional experience in the field, but had not pursued yet a specific academic education. As we are dealing with narratives, the subjects are protagonists in the action: they describe themselves, narrate themselves, at the same time presenting and constituting their selves to themselves and to others. We did not seek any kind of generalization, but rather to understand the experience in a critical perspective of education and of the distance modality, including tensions, misunderstandings and challenges.

When relating their experiences – which, according to Garnica (2004), are experiences with their own selves, thus non-transferable as experiences –, the subjects provide the researcher with elements that had not been considered before, allowing us to understand aspects of their reality. Researchers need to detect these moments through the meanings they attribute to what the subject says.

Lincoln presented himself as thirty-nine-year-old dark man, married and father of a daughter. He had been working as a Mathematics teacher in preparatory courses (to pass the college entrance exams) and giving private lessons in his city for at least five years. According to his words, he was also a public employee performing an activity

related to radiology in another city. In addition, he leads a religious group in his community. He started his description with these facts.

Rosângela described herself as a dark woman, a wife, mother and grandmother, a teacher and as being forty-seven years old. She used to work as an Arts teacher in the State Education Network and also taught Geometric Drawing in a private school. According to her words, she has been frequently called to substitute missing Mathematics teachers in schools (both public and private); the call was made available in public announcements.

Fernanda described herself as a black woman of twenty-nine years old, single, and frequently moved by the realization that she was fulfilling a dream – that of being a teacher. Firstly, she had set this dream in motion by structuring, in her house, a space for private lessons, in which the teaching of Mathematics prevailed. She owns a degree in Education and taught first grade as an employee in a Municipal Public Network school in her city but wanted very much to obtain an academic certificate in Mathematics.

These teachers decided to try and pass the entrance exam to a higher-level course in Mathematics at a public university linked to the UAB system. It was the first time they had the opportunity of studying Education with a specific focus on Mathematics, and in their respective cities. Once approved in the exam, they decided to pursue a profession that they already practiced: teaching Mathematics.

When questioned about their expectations towards the course and possible new learnings, Lincoln and Rosângela did not believe that the course would elicit many changes in their way of teaching and learning Mathematics but hoped that the distance modality would allow them a more autonomous style of studying. Fernanda wished to learn more about Mathematics and to become a qualified teacher. She also had an expectation regarding the process of distance education and questioned how the construction of knowledge in this process would take place.

The narratives on these subjects are presented in the next sections of this article. We sought to capture the meanings that they gave to their distance education in Mathematics and to the possible encounter between their practical knowledge and the one built through the learning process. Also, the study strategies undertaken by them in their search to presentify absences, as well as the challenges they faced.

## **BETWEEN EXPERIENCES AND KNOWINGS: TEACHER EDUCATION IN MATHEMATICS**

When investigating subjects who already had an experience in teaching Mathematics, we established an approach similar to the

one adopted by Fiorentini (2003), which identifies the Mathematics teacher as a subject capable of producing and resignifying, based on their practice, the knowings involved in their professional activity. Other references were the authors who consider, in their studies, different perspectives on the knowings of teachers (COCHRAN-SMITH; LYTLE, 1999; SHULMAN, 1986; TARDIF, 2002). Such theoretical approaches meant an attempt to analyze, based on these references, the possible encounter between the knowings accumulated by the teacher-students in their experience and the academic training in the context of distance education.

Cochran-Smith and Lytle (1999) affirm that there are different conceptions of teacher learning and varied images of knowledge, professional practice and social, intellectual and organizational contexts involved in the teacher's constitution. Three conceptions of teacher learning are highlighted in their studies regarding the different images that surround them: knowledge-for-practice; knowledge-in-practice; and knowledge-from-practice. The first one involves several training experiences that give access to a knowledge basis. In general, teachers will put into practice what they have learned from experts outside the classroom. The second one focuses on knowledge in action, involving reflections, investigations and narratives about the practice. Concerning the third, there is an understanding that, to the teacher, the meaning of 'practice' includes aspects of the intellectual, social and cultural context of teaching, and not only mechanisms of knowledge 'for practice' and 'in practice'. This is endorsed by Fiorentini and Crecci (2017) when discussing these conceptions 'For practice, In practice, and From practice'. They state that:

In the third conception - knowledge and learning FROM practice - there is no separation between practical and theoretical knowledge. It is presumed that the knowledge that teachers need to teach is produced when they take their own practice as a field of research or analysis, and the knowledge produced by other specialists as an instrument of interpretation and analysis. (FIORENTINI; CRECCI, 2017, p. 169)

The relation to the academic knowledge to which the research subjects were exposed paralleled the practice they experienced in their Mathematics teaching, even though they were not officially qualified for it. An important element in this analysis requires a deeper understanding of the meanings of practice. Carr (1987) (*apud* Cochran-Smith & Lytle, 1999, p. 291) outlines a perception on possible analyzes of the educational practice:

Past attempts to understand the concept of practice within the field of education have tended to follow the model of the natural sciences, in which theorization is considered something distinct from the phenomena studied. According to this view, practice is considered an atheoretical object - something that theories describe and not something inherently theoretical. The goal of theorizing, according to the natural sciences, is to acquire greater technical control over the phenomenal world. Thus, the concept of practice became crystallized in our minds as an inhabitant of the phenomenal world and not of the theoretical world. But to make such a distinction between theory and practice one must forget the nature of practice [...] In stating doubly that theory is non-practical, and that practice is non-theoretical, this approach always underestimates how much those engaged in educational practices should reflect, and therefore theorize, which is what they generally try to do. (COCHRAN-SMITH & LYTTLE, 1999, p.13-14)

The different knowings that emerge from the reality in the school work as references to the Mathematics teacher, constituting a considerable part of their professional culture. In what concerns the knowings involved in education, Shulman (1986) identifies them as 'subject matter content knowledge'; 'pedagogical content knowledge', which is the didactic knowledge of the subject to be taught; and 'curricular knowledge'. He proposed that teachers' knowings should be articulated as an amalgam, a mixture of different types of knowledge for teaching purposes, not privileging one in relation to another.

Tardif (2002) also refers to an amalgam of knowings when affirming that the knowing of the teacher can be defined as a plural knowledge, integrating different knowings and relationships arising from professional training, content, curriculum and experience.

Based on these conceptualizations, it was assumed in this research that the teachers' knowings are fundamentally social, that is, they are interrelated, engaged and forged in the social relations that involve the subjects and their encounters, everyday relationships and experiences, constituting, thus, an amalgam of knowings.

In this amalgam, it is not possible to isolate a single type of knowing, but our discussion starts from the experiential knowing, since the teacher-students involved in it possessed some of this already, before entering a higher education course. Such knowings and their meanings needed to be problematized and subjected to a critical reflection.

Nóvoa (1992) says that:

[...] training is not built by accumulation (of courses, of knowledge or of techniques), but rather through a work of critical reflexivity about the practices and permanent (re)construction of a personal identity. That is why it is so important to invest in the person and to provide a status to the knowledge from experience (NÓVOA, 1992, p. 25).

The search for this status, in relation to the knowledge from experience, was an essential part of this investigation, which was based on what the subjects narrated about their practical experiences in teaching Mathematics. Borges (2004) considers that the knowing gained from experience is fundamental for the teacher's constitution and serves as a basis for other types of knowledge. She affirms that: "(...) teachers do not speak of one knowledge, but of a set of knowings. They mention skills, competencies, talents, forms of know-how, etc. relative to different phenomena that are closely related to their work" (BORGES, 2004, p.67).

We sought to investigate the subjects' 'meaning of experience' regarding their teaching education in Mathematics, approaching the category of praxis as a means of facilitating our understanding:

We understand praxis as a material human activity which transforms the world and man himself. This real, objective activity is at the same time ideal, subjective and conscious. Therefore, we insist on the unity between theory and practice, a unity that also implies a certain distinction and relative autonomy. Praxis does not have such a wide scope for us that it can even encompass the theoretical activity itself, nor so limited that it is reduced to a merely material activity (VÁZQUEZ, 2007, p. 394).

Subject in this research, the teacher-student is a social, political being who lives dialectic and complex situations, and who sees himself/herself as a subject of action, positioned in face of his/her professional constitution. These are people who work and study, and who search qualification to remain in the exercise of teaching, which is done in relation both to work and subsistence.

The relation between knowing and knowledge, which is imbricated in the training and expressed in the doing, should always be problematized. Regarding Mathematics teacher education, Fiorentini and Crecci (2017) question the value of knowledge: what if it is not situated in a social practice? It needs to imply a meaning of better understanding the world and the practices. "We believe, in this sense, that the teacher's knowing to be and to do is transformed not by the simple application of knowledge, but by the problematization of the practices of teaching and learning, based on knowledge derived from research" (p. 168).

We sought to apply a critical view of human education, which considers that the constitutive processes of the subject are dialectical, historical and social. "Both in training and in professional practice, the teacher is in an imminently social action, subject to different internal and external scenarios and in the face of social struggles that involve disputes around political, socio-cultural and economic interests" (MOREIRA; FERREIRA, 2013, p. 985).



As stated by Freitas (2007), the cultural-historical approach involves the art of description complemented by explanation, emphasizing the understanding of phenomena based on their historical event, in which the particular is considered as an instance of social totality. Recognizing the subject in his/her encounter between the knowledge acquired from teaching practice and the academic one can lead us to understand (or give us clues to understanding) other scenarios of distance education for Mathematics teachers in the present historical context of Brazil, in which other individuals who have experiences similar to this one are located.

According to the study by Fiorentini and Oliveira (2013), the training of the Mathematics teacher<sup>4</sup> should be guided by the different social practices of the Mathematics educator. That is, the perspective of social practice is a dialectical movement of this being and doing with the world.

The modality of distance courses has been one, or the only one, choice for in-service teacher training, but it should not fail to be critically assessed. According to Belloni (1999) and Bairral (2007), the virtual learning environment can provide interactions and enable discourses based on the teaching-learning processes, representing a significant means of training for teachers. In a research on the 'Professional identity of Mathematics teachers', which offers an overview of researches in this field, Paula and Cyrino (2017) approach distance education and affirm that:

(...) studies show the current trend of increasing the supply of undergraduate teaching courses in the distance modality and problematize actions resulting from this demand, namely: myths and truths about distance education; difficulties with the use of Information and Communication Technologies; distance between teacher and students and interactions between future teachers and tutors. (p. 37)

Such problematization was part of the research described here, since it sought to look at the subjects and their scenarios as they were presented, with their contradictions and limitations.

From this perspective, the narrative research was directed towards the study of the experience of teacher education, based on these teacher-students' experience in their distance course in Mathematics and on the relation between knowings in their education.

## **BETWEEN NARRATIVES AND KNOWINGS: NARRATIVE RESEARCH AND THE AMALGAM OF KNOWINGS**

Clandinin e Connelly (2000) helped us understand better the narrative research investigation. They defined it as follows: "[...] narrative

investigation as a way of understanding experience. It consists of a collaboration between the researcher and the participants through time, in a place or in a series of places, and in social peer interaction” (p. 20).

Freitas e Fiorentini (2007) corroborate such perspective by affirming that the narrative may be understood as a way of reflecting and relating the lived experience, producing meanings of what we are, do and feel. It can also be seen, however, as a way of studying and investigating the experience.

As a means of investigating the experience, we defined instruments for the data collection, which mirror our methodological choices: questionnaire, interview, training memos, observations, and field journal, composing an amalgam and reflecting voices and educational experiences. With the use of all these instruments, we were able to build dossiers about the subjects. And, by polishing the dossiers, it became possible to elaborate analytical tables that allowed us to visualize each subject from the perspectives selected as possible analysis axes. Through these proceedings, we composed analytical tables that made it possible to construct the narrative of each subject. Based on them, we tried to draw threads around the greater plot of the encounter between practical knowledge and higher education offered by a distance course.

By telling stories about themselves and about their education, the individuals constitute themselves in the process as well. Through narratives, it is possible to expose analyzes by making public the meanings of the experience elucidated in the research.

Data have been organized based on the understanding that they do not exist independently, but only as a result of the theoretical questions used to approach them. Based on what was relevant in the texts, possible axes of analysis emerged: Mathematics in their lives; The meanings of being a teacher – knowings and encounters; Distance education in Mathematics.

The subjects involved in this research – Lincoln, Rosângela and Fernanda – reported their life stories and how they developed a relationship with Mathematics, also with teaching and with their distance education. These themes interrelated with their own life stories, since they are not seen in a dissociated way from the education movement itself. As experienced teachers, they had the expectation that the distance course would provide them a training that reflected what they already did, and some expected a more consolidated learning.

Distance education was the modality they would have as mediator in the course, but they hoped that the training process would be carried out with seriousness, after all, the course was linked to a federal university that offered the degree in Mathematics

in the face-to-face modality for a considerable time. This added a certainty about the content to be approached, the seriousness of the certification and the differentiated qualification they would achieve in their communities of professional practice. The course and the type of training were problematized at every stage.

Regarding their relationship with Mathematics and teaching, the subjects reported different ways of studying, planning classes and, at the same time, they criticized formats, curricula and the teaching that the school prioritized. This aspect should also be questioned: what lenses are being used in the analysis of the subjects? What are the lenses that establish the *modus operandi* of curricula and school knowings?

Fiorentini e Oliveira (2013) point out some perspectives of Mathematics teaching practices, being one of them the mastery of mathematical knowledge in an artisan fashion, based on the exercise paradigm. Another perspective is related to the application of knowledge produced by academic research, distanced from school practices, that may lead to a purely technical emphasis. Finally, there is also a practical perspective of the teaching of Mathematics as a social practice, being placed in relation to other knowings and disciplinary fields. The emphasis is on the relation knowing.

Because of their work as teachers, Mathematics was already part of their lives. Lincoln, Rosângela and Fernanda used, in their private lessons, the mathematical knowledge they accumulated based on the interest they had to learn in order to teach. The school locus was the most fertile field, according to them, to develop and also to criticize Basic Education requirements. Lincoln reports:

You learn to calculate, but you don't learn to problematize calculations... (...) don't know how to write in mathematical language (...). I taught spatial and analytical geometry in school because it was part of the program. (...) I never had a student telling me: I'm in need of geometry lessons. Or they learned everything... or they weren't taught.

So, I go see what is the content today. We have to see second degree equations, then that's it. Then I forget the book and go find something that I can search or such. I search for my own material. I only use the courseware for exercises. (...) then I say: Everybody, we gotta beat our brains out. (Audio transcription)

Rosângela tells how she started teaching Mathematics by reaffirming the lack of teachers in the area and the school system's need of someone who had some knowledge about the subject, even if they did not have proper training.

I had never taught Math, and I was in need of lessons and all, then they suggested: there are Mathematics lessons, take them! (...) I don't know enough Math to teach

this. Then xxx, also a teacher of Math, said: No, you can take them that I will help you, I help you if you have any questions. (...) Then I was given fifth and sixth grades. (...) It was the first time I taught Mathematics, I was trembling like... I mean, I taught only Geometry! (...) This was in 1995, 1996. I worked with the book 'Acertando o Passo', the accelerated of Mathematics. I started to give more lessons, in more cities (...). (Audio transcription)

Fernanda already gave private lessons, helping children with their homework and working on their difficulties. But she was faced with the demand of other students from the final grades of Middle and High School, as well as students of Youth and Adult Education (EJA), on issues related to Mathematics.

I began working with fifth to eight grades Mathematics, but later some students from High School 'appeared': Mathematics and Physics (...) Then came High School Math, then... they started... it was, some of them (...) from the youth and adult education, they really influenced me, they spoke like this: Wow, you know how to teach! You should pursue a Mathematics course!... (Audio transcription)

The relations established between the knowings gained from experience and the contents to be learned have become challenges to these subjects. In the exercise of their profession, teachers incorporate skills of know-how and know-how-to-be, as stated by Tardif, Lessard and Lahaye (1991). Amid these knowings, student-teachers were establishing their autonomy in teaching Mathematics, led by the constitution of an experiential knowing that was revealed at each step of a permanent education and built in the daily practice of teaching.

Larrosa (2002) cites that "knowing from experience is acquired in the way each individual responds to what happens to them throughout life" (p.23). Teacher education is a continuous process, always unfinished; it starts before higher level education and extends throughout life, as explained by Fiorentini (2003).

The experience of distance education in Mathematics brought to Lincoln, Rosângela and Fernanda what Larrosa (2001) suggested when thinking education from the perspective experience/meaning: "What comes to us, what happens to us". The subject exposed to experience can form and transform, and they were living an experience in their distance learning modality.

Distance education became a space for the exchange of experiences and for the interaction among students. Rosângela used forums (on the Moodle platform) to establish relations between her student and teacher experiences and the academic knowledge proposed. Her training in the teaching of Mathematics and her evaluation of the teaching of Mathematics were marked by the

experience in the area and, based on this experience, she sought to articulate new knowledge. She felt she was heard in the ‘virtual room of distance Mathematics’, expanding the debate with teachers and colleagues of the course and making use of distance learning tools. But she believed that the course was more demanding than what it should have been, according to her words:

What we are studying is like engineering. They want to train mathematicians, not teachers. They want Mathematics critics... thinkers... they are training us to be mathematicians, really... like, to analyze, prove this, prove that, a crazy thing. I even drew a circle, and then I have to prove that that is a circle... wow, I was horrified by that deal. All set, draw this circle, it's clear, ok, I even used a compass, look, what else do I have to prove? (Audio transcription)

Fernanda saw in the distance modality a possibility to study Mathematics, and this would not have been possible if she had to leave her city. In this case, it was not simply the search for a first experience in higher education, because she already had one. It was the search for an education in Mathematics.

Pursuing a course in another city, to pay for the commute, maybe even for the living, and still work would be much harder. And having a distance course in my city makes it a lot easier, I work in the afternoons, so I have free mornings to study at home, and in the evening, I can come to the face-to-face support center. So, it made it a lot easier. (...). It was the best opportunity I could have asked for. (...) And it's like... Now the distance course is such a wonderful experience, I'm loving it because I see myself doing things that I wasn't used to doing, like sitting and studying, doing research, things I didn't know. (Audio transcription)

About the practical and academic knowings seen in the course until then, she affirms:

... But I think I already have the Math in me. I have already, and I've been practicing a lot. Of course that it is like this, it is one way in the course, because there are times in which we are (...) content that is part of the course doesn't have much use, you know, much relation to what we do in the classroom, but as I say: Maybe, if I weren't studying Math, I wouldn't be spending time in front of the computer, searching Math-related topics. I only do this because of the course. So, for me, in a way, maybe the content doesn't help, but the thing as a whole is helping.

So, the course, the face-to-face course is not the same. We know that it is like this, during the day I don't take anything to study, then in the evening I will have a teacher there to explain all the content, but not in a distance course. It makes you study, so this, for me, has been a wonderful experience, pursuing this course makes me very happy, you know, I've been learned a lot, of course I'm still a little afraid that it will (...) that I'll learn, because we do have a notion of what we know. (Audio transcription)

A possible encounter of knowings, both from experience and education, has also taken place when the subjects found themselves forming a study group to deal with the distance course in Mathematics, as Fernanda tells. The group gave them the opportunity to bring to the table their teaching experience and other possible exchanges that had not been prioritized in the course yet.

So, as it is, the group has been working wonders. And it has been like this, a real help to keep us here in the course, and we can't forget, of course, the help from our tutors, who in reality have been very helpful, but, as it is, in addition to them we can count on this group. Because it really doesn't work, we discovered that studying alone, as it is, after our group, our group was the first one to be formed in the course. We noticed that other people began to set meetings as well. (Audio transcription)

The narrative not only expresses important dimensions of the lived experience, but, more radically, it mediates the experience itself and shapes the social construction of reality. "(...) the game of subjectivities, in a dialogical process, becomes a privileged way of building knowledge" (BOLÍVAR, 2002, p. 4).

Therefore, it is not possible to isolate knowings from their subjects in the narratives that were built. In a web of relations, we should consider the objective reality, the study conditions, meanings, significations, subjectivities, and the relations between teaching education experiences acquired from different study strategies. Amalgams of different types of knowings are thus constituted in a web of relations, as we are going to see next.

## ABOUT THE AMALGAMS

Considering the collected data and their relation to the field work, as well as the development of dossiers and of the analytical tables, besides the weaving of the subjects' narratives, we sought to identify the incidence of the most frequent ideas, facts, occurrences and themes in their stories so we could go on with our interpretative analysis.

Teixeira (1999) affirms that "each teacher is unique in their doings and in the meanings they attribute to their story, experiences and significations unscripted in the symbolical systems of the culture and the groups they belong to" (p. 89). We attempted to secure, while performing the analysis, a construction of singular meanings, but also trying to understand so many other subjects that experience distance education in Mathematics.

The different knowings that led them to become Mathematics teachers constitute an amalgam of experiential, specific, pedagogical

and curricular knowledge. At the start, it was experiential because of the relation they established with Basic Education students and, later, by embracing a teaching relation both in private lessons and schools. As for the specific knowledge, they used teacher coursebooks (with answer keys) as sources. Pedagogical and curricular knowledge was built through the contact with school programs and the coursebooks adopted by schools. All this knowledge expressed their constitution as teachers in their professional experience.

(...) to the teachers, the knowledge acquired through professional experience constitute the fundamentals of their competency. Based on them, teachers judge their prior education or the education accumulated during their career. They are equally based on them when they judge the pertinence or the practicality of the changes introduced in programs or methods. Finally, it is yet based on their experiential knowledge that the teachers conceive the models of professional excellency within their profession. (TARDIF; LESSARD; LAHAYE, 2002, p. 48).

Lincoln and Rosângela talk about themselves as people who have learned, and who possess a knowing from experience in relation to Mathematics; Fernanda admits a knowing and, at the same time, a 'non-knowing'. This might explain why she is more open to new experiences and knowings. Resistance to new learning might be a striking feature of teachers with a 'longer time' in the classroom, especially when those learnings provoke tensions. Perhaps because they already had a 'professional culture', when associating the knowing gained in their praxis with the academic content, they may feel led, by a possible tension, to resistance to change.

If teaching courses valued more the knowing accumulated by teachers with a long professional experience and considered it in the planning and development of their program, it is possible that these resistances could be problematized and positively used in some way. The configuration of the teaching courses with a focus on Mathematics and the way they are operated in the distance modality need to be questioned and discussed by researchers, teachers and students.

In the distance education course, tools such as chats and forums are examples of possibilities of interaction between students and teachers and among students. Belloni (1999) states that the effectiveness of the use of Information and Communication Technologies in distance learning processes will depend much more on the design of the teaching-learning processes that guide the courses than on the specific characteristics and technical potential of the tools.

The historical-cultural perspective contextualizes individuals in their own stories, with their subjectivity, tensions and contradictions, and this was considered in the investigation. Voices echoed and

wanted to be heard. While experiencing the courses, the subjects drew attention to some elements; one, specifically, extended the discussion about technologies in the teaching of Mathematics.

At first Lincoln was resistant and did not want to participate in the discussion forum. But then he felt provoked to participate by a discussion he was accompanying. He stated that he was not used to the employment of the computer and the Internet for teaching and learning, especially for the distance education in Mathematics. But his involvement in the course led him to know unfamiliar software, such as Geogebra,<sup>5</sup> as well as the possibilities of a differentiated work in the teaching of Mathematics. He mentioned that his way of thinking about some concepts changed thanks to his contact with technology, such as the construction of the Thales Theorem in Geogebra. One aspect instigated him: he was experiencing distance education with a focus on Mathematics mediated by technology, which led him to consider that, just as his way of learning was changing, it could change for his students as well.

Another important factor in the relationship with the course was the formation of study groups as a means of dealing with distance learning, which may be referred to a metaphor suggested by Garnica (2010) in 'Presentify Absences'.<sup>6</sup> The metaphor was used in this investigation on the distance education of Mathematics teachers given their need to presentify absences. They interacted with teachers through videoconferences, with tutors in face-to-face meetings and in study groups, but they always sought to presentify the absences they felt. This search was related to the education they experienced and to the filling of some apparent absences with which they were confronted.

Sometimes, these absences were not necessarily related to 'not seeing' and 'not having', but to not knowing how to deal with something. This was the strategy adopted by a group who settled face-to-face meetings, but also in the use of the available technologies (e-mails, forums, and others) to study, to develop activities and to presentify the 'apparent' distance. Also, the experiences related to the knowings obtained by praxis could be debated, shared in the forums and problematized in relation to the academic knowledge.

Amalgams enabled an investigative look at the possible encounters between different types of knowledge, especially those originated from practice and the ones acquired by academic education. We understood that these are not dissociated, but rather impregnated within a web of theoretical and living relations in the teacher education, in this case, mediated by distance learning.



However, it is necessary to consider the type of training undertaken by the Mathematics teacher in the distance modality and the articulation between epistemological and pedagogical knowings carried out in this education, avoiding reductions or generalizations.

## FINAL CONSIDERATIONS

The present article presented results of a research that had as main objective to narrate and analyze, in a critical perspective, the experience of teachers' distance education in Mathematics, when the knowing related to their teaching practice and the one obtained in higher education met. This landscape is full of tensions and contradictions derived from the distance training experience and from the distance course itself.

The teaching education of the subjects selected for this research had started long before their entrance in the distance teaching course with a focus on Mathematics: it is an amalgam of practical, pedagogical and curricular knowings that made it possible for them to exercise their teaching activity. They could problematize the Mathematics that they adopted in the classroom in relation to the academic one experienced in the course through various activities, including the ones developed in the discussion forums. Nevertheless, this path evidenced situations in which the Mathematics one learns and teaches requires epistemological, historical and social views and bases, which are built through problematization and criticism and need to be revised and transformed. Teaching praxis takes place mainly in Basic Education, therefore, according to Valente (2013, p. 946), it is important to “(...) create situations that place the future teacher in the historical-epistemological discussion of the constitution of school Mathematics”. This does not reinforce the exercise paradigm, for instance, but points to a changing movement of practices that have already been questioned.

An important indication of the distance learning movement was perceived through the study strategies undertaken by the student-teachers, such as the search to presentify absences, creating study groups and other forms of interaction. This again demonstrates that the distance learning modality cannot exclude the relationship among peers through discussions, exchanges, questionings and learning interactions. Fiorentini and Oliveira (2013) emphasize that:

(...) Mathematics, as a social practice of the mathematician educator, is always a knowing of relations. (CHARLOT, 2001) Relation with the world, with oneself, with other individuals, particularly in situations of production and negotiation of meanings

in the communication process, of teaching and learning or of use/exploration of mathematical procedures. That is, in the mathematician educator's action, Mathematics is always situated in a concrete social practice, in which it gains meaning and form/content of its own, being recognized and validated in/by the work. (p. 922).

Distance courses could problematize the exercise of Mathematics education as a social practice, also considering the use of Information and Communication Technologies within the process of teaching and learning, without ever assigning them, however, a role of supremacy among other technologies, even non-digital ones. This leads to a critical reading of the use of these technologies, since the change of medium should also mean a discussion about language itself.

Borba and Villarreal (2005) propose the 'humans-with-media' metaphor to describe individuals as builders of knowledge; This metaphor places media in a non-external position in relation to people; it builds knowledge along with them. Man's interaction with non-human collectivities may enable the reorganization of thought. The present research emphasizes that the distance education with a focus on Mathematics may generate changes in the knowing processes and differentiated connections of teaching and learning, suggesting other languages, signs and other forms of interaction that need to be better investigated.

The subjects showed this when they mentioned a more frequent use of the Internet for research and a greater contact with different people and spaces to clarify doubts and rethink aspects about Mathematics education that had never been thought until then. The use of software such as Geogebra in the teaching and learning of geometry allowed all of them to see different ways of using ICTs in education.

Another consideration for reflection is what Fernanda points out by saying "I did not imagine that all this was behind what I taught to my students about Mathematics". The subjects made associations between what they experienced as teachers and their learning as students and talked about how they could establish a dialogue between them in the distance education course. Fiorentini and Oliveira (2013) cite Ball (2000) regarding three major problems in teacher education:

The first is to identify the knowledge of content that matters for teaching; the second is to consider how such knowledge has to be studied and understood to be taught; the third is to create opportunities to learn content in a way that enables future teachers not only to master the knowledge of content, but also to know how to use it in a variety of contexts of practice. (p. 929)

Some situations regarding teacher education with a focus on mathematics that emerged during the research require further investigation. One of them is related to the role of the university

concerning the tripod Teaching, Research, and Extension. We have not seen observations related to research and extension proposals in the practices that we analyzed, neither in the Pedagogical Project of the course. We believe it to be something ‘common’ in distance learning courses. But is this a way of carrying out academic education? Is it based solely on teaching and for teaching?

Thus, this study points to other possibilities of research and works on teacher education, especially in the Mathematics field and considering distance learning as an alternative, based on the significant increase of this modality as a governmental political guideline to teacher education within the Brazilian educational context.

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## NOTES

<sup>1</sup>The Open University System of Brazil [has] a focus on the Policies and Management of higher education. (...) UAB is a program created by the Directorate of Distance Education (DED) of the Coordination of Improvement of Higher Education Personnel (Capes), in articulation with the Secretariat of Distance Education (SEED) of the Ministry of Education (MEC). Among UAB's assignments is the articulation between public higher education institutions to offer distance courses in face-to-face support centers, mainly distributed in inland municipalities of the country (Brazil, 2008).

<sup>2</sup>Designation given in this research to the subjects who were already Mathematics teachers and became students of distance education courses with a focus on Mathematics teaching.

<sup>3</sup>[www.moodle.org.br](http://www.moodle.org.br)

<sup>4</sup>The term “teacher training” and its variations are used in this paper with the same meaning as “teacher education” to avoid repetition of expressions.

<sup>5</sup>Geogebra is a free dynamic geometry program created by Markus Hohenwarter to be used in the classroom. Available on: <http://pt.wikipedia.org/wiki/Geogebra>.

<sup>6</sup>He recounted the history of Pompeii (79 AD / 18th century), which was destroyed by the Vesuvius volcano. Much later, archaeologists, in their excavations, discovered ‘stones’ with large ‘voids, hollows’ and tried to unravel the mystery. They decided to ‘fill the void’ with plaster and found that it was the shape of bodies of people and animals that had been petrified by the volcanic lava. Even with the decomposition of bodies caused by time, volcanic ash preserved their shape. Based on this technique, they rescued the history of that people, by ‘presentifying the apparent absence’.

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**Contact:**

Diva Souza Silva  
Faculty of Education, Federal University of Uberlândia (UFU)  
Av. João Naves de Ávila, n. 2121, Santa Mônica  
Uberlândia | MG | Brasil  
CEP 38.408-100