**DOI**: 10.1590/0104-4060.68973

# A study on the research on initial training of teachers who teach mathematics in the initial years of schooling[1]

# *Um estudo acerca da pesquisa sobre formação inicial de professores que ensinam matemática nos anos iniciais de escolarização*

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**ABSTRACT**

This is the result of a descriptive-analytical documentary study about investigative questions and results presented by theses developed in the areas of Education and Teaching of Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) which focus on the process of Initial Training of Teachers who teach mathematics in the early years of schooling. It has as research source the Brazilian academic production gathered by the research Mapeamento e Estado da Arte da Pesquisa Brasileira sobre o Professor que Ensina Matemática (Mapping and State-of-the-art Review of the Brazilian Research on the Teacher of Mathematics) of Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) consisting of 858 works from 2001 to 2012. From the corpus of 63 theses identified, 12 were selected using the descriptors "Pedagogy" and "early years" in the title. The theses were organized and analyzed according to the thematic dimensions "mathematical content", "didactic-methodological aspect", "construction of knowledge and production of meanings" and "curricular internship". The descriptive analysis shows theses related to the teacher who teaches mathematics whose subjects are important, but are focused on

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the verification of emphases not necessarily linked to the process of teacher training in the Pedagogy Graduate Course. Also, there are few ones that have as investigation question the process itself of the initial training of teachers who teach mathematics in the early years of Elementary School.

*Keywords*: Initial Training. Mathematics and Pedagogy. Mathematics Early Years. Mathematics Teachers Training. Mathematics Teachers Early Years.

**RESUMO**

Trata-se do resultado de um estudo documental descritivo-analítico sobre questões investigativas e resultados apresentados pelas teses desenvolvidas nas áreas de Educação e de Ensino da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) que tem como foco de estudo o processo de Formação Inicial de Professores que ensinam matemática nos anos iniciais de escolarização. Tem como campo de investigação o banco da produção acadêmica brasileira produzido pela pesquisa "Mapeamento e Estado da Arte da Pesquisa Brasileira sobre o Professor que Ensina Matemática" do Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) constituído por 858 trabalhos no período de 2001 e 2012. Do *corpus* de 63 teses identificadas, foram selecionadas 12 por meio dos descritores "Pedagogia" e "anos iniciais" no título. As teses foram organizadas e analisadas segundo as dimensões temáticas "conteúdo matemático", "Aspecto didático-metodológico", "Construção de saberes e produção de sentidos" e "estágio curricular". A análise descritiva mostra teses relacionadas ao professor que ensina matemática cujos temas são importantes, mas estão voltados a verificação de ênfases não vinculadas necessariamente ao processo de formação dos professores no curso de Pedagogia. Também, são poucas as que têm como questão de investigação o processo em si da formação inicial de professores que ensinam matemática nos anos iniciais do Ensino Fundamental.

*Palavras-chave*: Formação Inicial. Matemática e Pedagogia. Matemática Anos Inicias. Formação Professores Matemática. Professores Matemática Anos Iniciais.

## Introduction

Researches about teacher training are not recent. Gatti (2010) identified that such researches occur since 1950. Gatti presents the results of a research carried out in 2008, in which, by means of a representative sample, carried out the analysis of the curriculum structure and of the study programs of 165 courses

from higher education institutions, in which the major ones are: 71 Pedagogy, 31 Mathematics, 31 Biological Sciences and 32 Portuguese Language. Among her results, we highlight that the mathematical contents are studied in a specific way in only 18% of private institutions and that no public university has in its curriculum subjects dedicated to "Portuguese Language and Mathematics. Such contents remain implicit in the courses related to teaching methodologies, or they are assumed to be known by the students who take up training courses" (GATTI, 2009, p. 124). By the time that Gatti was the research coordinator at the Carlos Chagas Foundation, she gave an interview to Época Magazine and stated in its November 14, 2016 headline that "One of the major Education researchers in Brazil says that most of the mind sets in Pedagogy Graduate Courses is anachronistic and does not meet the social demands of the country".

Mindal and Guérios (2013) identified that few researches in the Brazilian scenario focus on teachers themselves and on the specificity of their education. In the mapping these two authors carried out in the CAPES' theses database and in the papers published on the SciELO/Brazil website from 2006 to 2013, they found 2,550 works when using the key words "teacher training". Different themes touch it, but it is not the focus of interest. Focusing on the teacher who teaches mathematics, Guérios, Cyrino, Lopes and Melo (2016) found the same scenario in Southern Brazil. While analyzing a *corpus* composed of 131 researches between dissertations and theses ranging from 2001 to 2012, they observed that few have the teacher who teaches mathematics as the focus of study.

Considering: a) the structure of Teacher Training as an autonomous field of study as André (2010) points out, b) the profusion of scientific production in the CAPES' *strict sensu* Post Graduate Programs in the fields of Education and Teaching, c) the links between learning outcomes and teacher training for Primary and Secondary school Education, it became a matter of interest to us to enter the field of the initial training of teachers who teach mathematics in primary school in order to identify research questions and presented outcomes[2].

## Study route

This research has as its source of investigation the theses' database produced in the context of the research called "Mapping and State of the Art of the

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Brazilian Research on the Teacher who Teaches Mathematics" (CNPq)[3]. The goal was to map, describe and systematize Brazilian researches that focused on the teacher who teaches mathematics, as developed in the CAPES' *stricto sensu* Post Graduate programs in the fields of Education and Teaching ranging from 2001 to 2012. In its first phase[4], the Brazilian researches produced in the CAPES' *stricto sensu* Post Graduate programs in the fields of Education and Teaching that have as an emerging field of study the teacher who teaches mathematics were mapped, described and systematized. This mapping generated a *corpus* consisting of 858 theses and dissertations, a number which included 178 PhD researches, 588 academic masters' degree researches and 92 professional masters' degree researches. To carry out the mapping process, 32 researchers assembled working groups by country region, organized according to Chart 1.

CHART 1 - NUMBER OF RESEARCHERS AND RESEARCH *CORPUS* BY REGION

| Research Groups | Number of researchers | *Corpus* by Region |
|---|---|---|
| **North** | 2 | 51 |
| **South** | 4 | 131 |
| **Northeast** | 4 | 110 |
| **Central-west** | 3 | 86 |
| **Rio de Janeiro/Espírito Santo** | 4 | 71 |
| **Minas Gerais** | 3 | 60 |
| **São Paulo** | 12 | 349 |
| **Total** | **32** | **858** |

SOURCE: Adapted from the e-book "Mapping of Brazilian Academic Research on the Teacher who Teaches Mathematics" (2016).

In the second phase, metanalytical studies were accomplished, as a result of the elaboration of files out of the theses, in order to produce syntheses about specific subjects focused on the research *corpus* about the teacher who teaches mathematics. New groups were assembled by subject, no longer by regions. In the group these authors were a part of, it was chosen to analyze the theses. They were organized into four (4) axes numerically expressed in Table 1: initial

3 Notice Call Universal MCTI / CNPq no. 014/2014. Coordination: Dr. Dario Fiorentini (UNICAMP).

4 Structuring, methodology and research results can be found at: https://www.fe.unicamp.br/pf-fe/pf/subportais/biblioteca/fev-2017/e-book-mapeamento-pesquisa-pem.pdf.

training (FI), continuing education (FC), initial and continuing training (FIC) and other contexts and aspects of training (OC). In this paper, we chose the FI axis' theses as the basis for the analyzes and, among them, those that deal with initial teaching training for primary school.

TABLE 1 – ANNUAL AND CONTEXTUAL DISTRIBUTION OF THESES THAT HAVE THE TEACHER WHO TEACHES MATHEMATICS AS THEIR FIELD OF STUDY

| | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FI** | 1 | 1 | 2 | 2 | 3 | 1 | 5 | 8 | 6 | 11 | 8 | 15 | **63** |
| **FC** | 0 | 2 | 4 | 1 | 2 | 2 | 6 | 3 | 3 | 3 | 7 | 12 | **45** |
| **FIC** | 0 | 1 | 0 | 2 | 0 | 1 | 2 | 0 | 1 | 1 | 0 | 1 | **09** |
| **OC** | 3 | 1 | 0 | 1 | 4 | 6 | 10 | 5 | 13 | 6 | 4 | 8 | **61** |
| **Subtotal** | **4** | **5** | **6** | **6** | **9** | **10** | **23** | **16** | **23** | **21** | **19** | **36** | **178** |

SOURCE: *Database of the* Mapping Brazilian Academic Teacher Teaching *research* (CNPq).

In the table we have 63 theses that approach teachers` initial training. After the analysis work in these theses, we constituted the *corpus* of this paper with those related to the theme of initial teacher training for primary school using the key words "pedagogy" or "Primary School" in the title. The theses were organized by focus of analysis, for which we kept the ones established in the construction of the database presently discussed: Traditional knowledge, knowledge, skills of the future teacher, courses / programs / projects of teachers initial training, training, learning and professional development and other focus of analysis (teaching or professional practice of the Teacher who Teaches Mathematics).

There are twelve (12) selected theses. The methodological approach is the descriptive one with the purpose of elaborating analytical syntheses about the investigative questions and the constructed results, giving visibility to the theoretical references that support these researches. From this perspective we established the question that guides this study in the following terms: What do PhD researches say about the initial training of the teacher who teaches mathematics in primary school?

## The theses

The theses that compose the *corpus* are those of Gonçalez (2002), Bukowitz (2005), Zimer (2008), Oliveira (2009), Santos (2009), Palma (2010),

Ortega (2011), Ferreira (2011), Rodrigues (2011), Carneiro (2012), Marquesin (2012) and Macedo (2012). Regarding the Focuses of Analysis, the theses are distributed as follows:

TABLE 2 – LIST OF THESES BY FOCUS OF ANALYSIS

| FOCUS OF ANALYSIS | THESES LISTED BY AUTHORS |
|---|---|
| Traditional Knowledge, knowledge, skills of the future teacher. | (ORTEGA, 2011) |
| Courses / programs / projects of initial training. | (FERREIRA, 2011); (GONÇALEZ, 2002); (MARQUESIN, 2012); (PALMA, 2010); (POZZOBON, 2012), (RODRIGUES, 2011); (ZIMER, 2008). |
| Training, learning and professional development. | (BUKOWITZ, 2005); (CARNEIRO, 2012); (OLIVEIRA,2009) |
| Other focuses of analysis (teaching or professional practice of the teacher who teaches mathematics). | (MACEDO, 2012) |

SOURCE: Database of the research Mapping Brazilian Academic Research on the Teacher who Teaches Mathematics (CNPq).

In the focus of analysis courses / programs / projects of initial training we have the largest number of theses. Some of them have two or more research focuses. We chose to consider each thesis considering only one of them, through an analytical effort to identify the predominant focus. To organize the theses we created axes that we call Thematic Dimensions, trying to create a guiding thread between them. It is observable from their titles that some of the theses belong to more than one of these dimensions. We chose to insert them in the dimension in which we approached their respective investigative questions.

TABLE 3 – THEMATIC DIMENSIONS

| Thematic Dimension | Author | Title |
|---|---|---|
| Mathematical content in Pedagogy Graduate Courses | MACEDO (2012) | Dienes' theory in the teaching of transformation of length, area and volume measurements in Pedagogy Graduate Courses. |
| Mathematical content in Pedagogy Graduate Courses | RODRIGUES (2011) | Probability as a curricular component in the initial mathematical training of multipurpose teachers. |
| Mathematical content in Pedagogy Graduate Courses | CARNEIRO (2012) | Mathematics' Formative processes of primary school student-teachers in e-learning Pedagogy Graduate Course. |
| Mathematical content in Pedagogy Graduate Courses | GONÇALEZ (2012) | Attitudes of Pedagogy undergraduate students regarding the subject of statistics in the computer lab. |
| Didactic-methodological aspect | ZIMER (2008) | Learning to teach mathematics in primary school. |
| Didactic-methodological aspect | OLIVEIRA (2009) | Mathematics Teaching, History of Mathematics and Artifacts: a possibility of linking knowledge in training courses for early childhood education teachers and primary school teachers. |
| Didactic-methodological aspect | FERREIRA (2011) | History and Pedagogy of Mathematics Workshops: Contributions to the Training of Teachers who Teach Mathematics in primary school. |
| Didactic-methodological aspect | BUKOWITZ (2015) | Investigative Practices in Mathematics: A Work Proposal in Pedagogy Graduate Courses. |
| Knowledge construction and meaning production | ORTEGA (2005) | The construction of knowledge of Pedagogy undergraduate students regarding mathematics and its teaching during initial training. |
| Knowledge construction and meaning production | PALMA (2010) | The production of meanings about learning and teaching mathematics in the teachers initial training of early childhood education teachers and primary school teachers. |
| Knowledge construction and meaning production | (POZZOBON, 2012) | Mathematics teaching practices: regimes and truth games in the training of primary school teachers (1960-2000). |
| Curricular stage | MARQUESIN (2002) | Training spaces and the constitution of teaching professionality: internship and the teaching of Mathematics in primary school. |

SOURCE: eBook Mapping Brazilian Academic Research on Teachers who Teach Mathematics (2016).

## Research Perspectives regarding Teachers who Teach Mathematics in Primary School

We noticed that the researches by Gonçalez (2002), Bukowitz (2005), Zimer (2008), Palma (2010), Ortega (2011) and Carneiro (2012) adopt the relationship of Pedagogy undergraduate students' senses, attitudes, visions, conceptions and its changes as the focus of their studies, while the researches by Oliveira (2009), Santos (2009), Ferreira (2011), Rodrigues (2011), Marquesin (2012) and Macedo (2012) address the possible uses of trends, artifacts and formative spaces, as influencing elements in the training of the teacher who teaches mathematics in these graduate courses. Based on these ideas, the following presents a descriptive analysis of these researches.

Regarding the thematic dimension Mathematical Content in Pedagogy Graduate Courses, we will discuss the theses of Macedo (2010), Gonçalez (2002) and Rodrigues (2011).

Macedo (2010) investigated a teaching module based on Zoltan Dienes's theory, focusing on the contents of length, area and volume measurements transformation with undergraduate Pedagogy students. The research methodology consisted of an experimental study with the application of a previous test in order to evaluate the mathematical knowledge of the undergraduate Pedagogy students and an after-test as an instrument of assessment of learning after interventions with mathematical games. Macedo (2012) found that undergraduate Pedagogy students reached a cognitive level of reflective abstraction with the use of resources and games based on Dienes's theory, a fact that contributed to the understanding of the mathematical concepts involved. In fact, although identified by the descriptors, this thesis is mostly aimed at the evaluation of didactic resources than to teacher training itself.

Rodrigues (2011) indicates the knowledge needed to compose a proposal for probability teaching in the initial mathematical training of multipurpose teachers so that they are able to teach this content in primary school, namely: the knowledge of justifications for the inclusion of this content in proposals for mathematics teaching since primary school; the knowledge of objectives one intends to achieve with studies related to probability in this level of education; knowledge of the classical, frequentist and subjective probability interpretations; knowledge of the mathematical tools that are used in classical and frequentist probability interpretation.

Carneiro (2012), with the objective of investigating Mathematics formative processes of nine students from e-learning Pedagogy Graduate Courses who

already taught in primary school, inquired about which formative processes are evidenced by student-teachers when these students take part in specific mathematics subjects in a e-learning Pedagogy Graduate Course. The hypothesis was that the formative processes experienced by the students, as teachers, could have contributed to their professional development, promoting learning of mathematical content as well as teaching learning. The analysis occurred in two thematic axes, one being the relationship with mathematics and its teaching and learning and the other axis being the formative processes in mathematics. Among the conclusions pointed out is that "the formative processes experienced by the student-teachers promoted the (re)construction and (re)signification of the mathematical contents that were approached and also provided teaching learning" (p. 250), and that the "formative processes provided in the mathematics-related subjects of the e-Learning Pedagogy Graduate Course promoted the professional development of the student-teachers" (p. 245), and the perception of "clues that there were some minor changes in the student-teacher's beliefs" (p. 249) and that, during their school lives, the teaching and learning of this classes were based on memorization, mechanization, among others, that is to say, in stagnant teaching and learning practices. The research also revealed what their relationship to mathematics and its teaching and learning was like, or still is. Thus, feelings of trauma, anguish, fear and aversion emerged, but also enjoyment for the class. According to the author, the research brought evidence that the formative processes experienced by the student-teachers promoted the (re) construction and (re)signification of the mathematical contents approached and provided teachers` learning. The research also indicated changes in teachers` learning related to pedagogical knowledge of the content with regards to the manner of approaching it, as well as concerning general pedagogical knowledge.

Gonçalez (2002) investigated the attitudes of Pedagogy undergraduate students regarding Statistics by means of a quantitative research. Data from the answers to 1096 questionnaires revealed that "Most subjects opted for the Pedagogy Graduate Course as a vocation, 558 students had more favorable attitudes towards Statistics and 538 students had less favorable attitudes towards Statistics" (Summary). The methodological route occurred in two phases. In the first one, interviews about the students' attitude towards statistics and mathematical problem solving were carried out. All problems were solved using computers. These problems were selected from textbooks used in primary school and adapted for Pedagogy undergraduate students. The mathematical contents listed in the problems are related to what the future teachers will need to teach. In the second phase, 259 students engaged in computers during Statistics classes and it was noticed that "the students started the Graduate Course with little knowledge of the basic concepts of Mathematics and, throughout the course, developed favor-

able attitudes towards Statistics, claiming that computer use facilitated learning" (Summary). In the 2nd phase a mathematics test was applied, exploring basic knowledge, which demonstrated the Pedagogy undergraduate student's lack of basic mathematics knowledge.

We observed in Macedo (2010), Rodrigues (2011), Carneiro (2012) and Gonçalez (2002) that the mathematical content in the Pedagogy Graduate Course was a concern and that researchers are focused on the verification of emphases not necessarily linked to the teacher training process in this graduate course.

Regarding the issue "Didactic-methodological aspect" we will approach the theses of Bukowitz (2005), Ferreira (2011), Oliveira (2009) and Zimer (2008).

In Bukowitz (2005) there is no explicit research problem. The researcher developed a work proposal in the Pedagogy Graduate Course with investigative practices in mathematics by means of workshops, intertwining research and teaching. It aimed to intervene on students' conceptions and practices related to the approach of mathematics teaching in primary school, aiming to transform "ingrained practices which are considered 'safe', proposing innovative ways, admitting "the awareness of teachers to change" (p. 20) as a possibility. It did so because getting in touch with the undergraduate students shows a progressive deterioration of the teachers` character as an educator and specifically the reduction of the repertoire of mathematical knowledge that is necessary for teachers in order to promote the mediation between such knowledge and the primary school student. "It culminates in an analysis of the impacts that these investigative mathematical practices have on different Learning Communities" (p. 9). The theoretical discussion was based on two major foci, Gramsci's philosophy of *praxis* and Imbernón's construction of Learning Communities. During the workshops, the teachers in training, drawing from their memories of classroom practices, problematized real situations of their daily teaching. Thus, pedagogical knowledge was mobilized and socialized in a study group session. The knowledge shared in the Learning Communities was built around the following mathematical contents: division, decimal numbering system, fraction, perimeter and area, which were developed in four workshops. Thus, the results and conclusions of the research emerged from the workshops. A need to change the dynamics of teacher training courses and of schools arose. Finally, the research points to a certain dichotomy between theory and practice, that is, what the course programs (theory) define and what actually happens at the schools (reality of the daily life of the classroom).

It`s interesting to notice that Bukowitz (2005) and Carneiro (2012) approach the Pedagogy Graduate Course in different ways. Both are concerned with the initial education of pedagogy undergraduate students regarding the

preparation for teaching mathematics in primary school, and their research investigates different areas of teacher education. We emphasize that Bukowitz (2005) and Carneiro (2012) investigated mathematical education in Pedagogy Graduate Courses. The first of these researchers developed investigative practices in mathematics, intertwining research and teaching with interventional purposes about the teachers' conceptions and practices surrounding mathematics teaching in primary school in order to make these teachers aware to change. The second researcher focused on the mathematical education of female students who already taught ane-Learning Pedagogy Graduate Course, with interventional purposes on the practice they already develop. We understand that Carneiro (2012) sees initial education a formal moment of education (PONTE, 1996) in the professional development of teachers who teach mathematics, given that he takes into consideration the professional experience of Pedagogy undergraduate students prior to their admittance. The very term "student-teachers" which the author uses to refer to his research subjects denotes this perception.

Zimer (2008) seeks to understand possible ways to narrow the relationship between theory and practice in the education of primary school teachers, having as her theoretical focus the socio-historical theory announcing the ideas of Leontiev (1988) and Moura (2001) and also reports herself to the Conceptual Change Theory, as proposed by Abib (1996); Porlán, García e Martín del Pozo (1997), Villani and Freitas (2002), among others. To address teaching knowledge, the author brings the ideas of Ponte (1994), Bromme (1994), Bromme and Tillema (1995) and Tardif (2010). She does not employ the word "Internship" in the title of the thesis, but its central research question was to know how three Pedagogy undergraduate female student-interns "gradually established connections between their conceptions regarding mathematics and pre-professional pedagogical practice in order to be enabled to understand how they learn to teach mathematics" (p. 118). She found that the students studied theoretical aspects about the subject, but without "having the possibility of establishing associations with classroom situations based on observations and/or experiences lived by themselves as future teachers, since they did not yet develop internship activities related to pedagogical practice (...)" (p. 116-117). The author emphasizes the importance of the teacher educator as a mediator between the students' personal conceptions and the pedagogical practice they develop. "Thus, one esteems that the analysis of conceptual evolution constitutes an interesting pathway for discussions related to the education of teachers who will teach mathematics in primary school" (Summary). One of the results observed in Zimer's research (2008) is characterized by the fact that, at the end of the investigation process, the subjects revealed new ideas about Mathematics and the teaching-learning process, showing that the establishment of connections between these con-

ceptions and pedagogical practice constituted, for these subjects, a pathway permeated by obstacles, conceptual and emotional disturbances, reflections and the elaboration of new learning. Among Zimer's conclusions (2008), we highlight the influence of the teacher educator in the constitution of the conceptions of the subjects she investigated, for they kept systematized ideas based on the views of their elementary and high school teachers. Thus, the author emphasizes that the way teachers present mathematics to their students can influence their conceptions of mathematics and their teaching along their educational trajectory.

The next theses, by Oliveira (2009) and Ferreira (2011), address didactic-methodological aspects involving the history of mathematics and the history of humanity itself.

Oliveira (2009) investigated the possibilities and consequences of the use of historical artifacts in teaching activities in teacher training courses for early childhood education and primary school. Oliveira's research is based on the ideas of authors dealing with teacher education, namely: Nóvoa (1995), Schon (2000), Tardif (2002), Zeichner (1993), Perrenoud (2002), Fiorentini, Nacarato and Pinto (1999) among others. To discuss the use of History of Mathematics as a methodological resource she sought support in the ideas of Fossa (2001 and 2006), Mendes (2001a, 2001b), D'Ambrósio (1996), Miguel (1993 and 2005), Brito (2007) and others. To clarify the role of artifact in history and as a mediating element of learning, the author anchored herself in studies made by: Vygotsky (1991 and 1993), Oliveira (1993), Le Goff (2003), Certeau (2007), Pinsky (2006) among others. As main conclusions, the author states that the artifact can be considered as an element of mediation between teaching activities and the object of study and that it enables an integrated work between the fields of knowledge. Regarding teachers, the author states that this way of facing the teaching process contributes to the understanding of multipurpose teachers that the knowledge and actions of teachers cannot be seen in a fragmented way. Early childhood education and primary school classrooms should reflect this idea of interconnection between the addressed contents, contributing to the development of creativity, of the sense of the actions of past humans and to change the way of facing mathematical knowledge.

Ferreira (2011) investigated what is the contribution of History and Pedagogy of Mathematics workshops in the initial education of teachers who teach Mathematics in primary school, with a view to propose the inclusion of History of Mathematics as a didactic and conceptual mediator resource in the continuing education of teachers who work in the public school system of Teresina. "For the author, it is a challenge to talk about history in the teaching of mathematics, especially when we want to relate it to the education of primary school teachers, that is, those with a degree in Pedagogy, qualified to teach in Primary School"

(p. 18). Following the research with groups of Mathematics and Pedagogy undergraduate students, the study "pointed out a way of teaching and learning school mathematics in the Primary School, using History of Mathematics as a didactic and conceptual mediating resource" (p. 188). The author approached the technical rationality paradigm, criticizing the training courses structured in that profile. She states that the methodological approach of the History of Mathematics can enable meaningful teaching that takes into consideration the cultural, social and historical aspects of this science. The author states that the history of mathematics can be a mediating resource that articulates scientific knowledge and practical knowledge in the activities of teachers who teach mathematics in the primary school. Thus, the difficulties Pedagogy undergraduate students face, for example, can be overcome with the workshops, because, in this training space, the students can learn specific mathematical contents. Ferreira (2011, p. 188) concludes her research by stating that "the study pointed to a possible pathway on how to teach and learn school mathematics in primary school, using the history of mathematics as a didactic and conceptual mediating resource".

Regarding the thematic dimension "Knowledge construction and meaning production" we will approach the theses of Ortega (2005), Palma (2010) and Pozzobon (2012).

Ortega (2011) investigated the contribution of Pedagogy undergraduate courses to primary school teachers, in the process of constitution of knowledge with regards to the nature of mathematical knowledge and its teaching. To answer the question about how teachers, who teach Mathematics in primary school constitute, reformulate and transform their knowledge during the Pedagogy Graduate Course, the author considered the organization of this graduate course, the work of teachers who deal with the different subjects that compose the graduate course's program, the involvement in research projects and the conditions they experience as undergraduate students, as variables that interfere with the way in which these teachers in training build their knowledge concerning mathematics and its teaching. The researcher contacted 09 Pedagogy undergraduate students for 04 years in order to identify, in each year of the duration of the course, how these subjects built their meanings and established relations between new knowledge and that which they already possessed regarding mathematics and its teaching. According to the author the students started the graduate course claiming to be afraid of mathematics; reported difficult experiences during elementary and high school; and claimed to be unable to learn mathematical concepts. At the end of the course, those students expressed to be more comfortable since they described, "less fear and claiming to feel safer if they eventually teach in primary school because they managed to break the idea that mathematical knowledge is a "monster", and believe it can be taught with meaning" (p. 129). The theoretical

framework was discussed by Ponte (1994), Shulman (1986), Bromme (1994), Bromme and Tillema (1995), Barth (1993) and Tardif (2010) who examined teaching knowledge.

Palma (2010) investigated "the movement of meaning production about teaching and learning Mathematics of four Pedagogy undergraduate students in the initial training path and how they sustain the meanings they produce" (p. IX). She concludes that participation in the supervised internship allowed the students to produce new meanings for teaching and learning mathematics. In this process, in addition to historicity, the research "considered the fundamental role of contradictions and of the multivocality present in systems of training activity" (p. 170). The theoretical framework is based on the socio-historical theory and around the ideas of Monteiro (2002), Palhares (2003), Serrazina (2002, 2003), Blanco Nieto (1996), Llinares (1996) and Ball (1991), who discuss the curriculum of Pedagogy Graduate Courses, to say that these graduate courses sometimes do not include specific subjects of Mathematics and its teaching and learning processes, or they are characterized by allocating a very small workload to these discussions. The author concluded that the students presented the production of new meanings about learning and teaching mathematics after the activities developed in the training process of the subjects involved in the research. She refers the importance of interactions during the course as a fundamental factor, because she establishes that all activity systems are collective and constitutes part of the interactions of multiple voices. She quotes Moita (1995, p. 115) when that author says that "nobody educates themselves in a vacuum. To educate oneself presupposes exchange, experience, social interactions, learning, and endless relationships".

Pozzobon (2012) problematized the training of teachers who teach mathematics in primary school drawing from a high school level teacher training course of a school in the Rio Grande do Sul countryside, from the 1960s to 2000, considering some approximations of Foucaultian studies, in the fields of education and mathematics education. The questions that guided the research are as follows: how did mathematical knowledge constituted the teaching practices of high school mathematics of the analyzed Training Course? What mathematics teaching practices operated in the training of primary school teachers in the analyzed period? The author concludes that "mathematical practices have been constituted from truth regimes that act as truth statutes about the education of teachers to teach mathematics in the early years of schooling (...)" (p. 139) involving conceptions of scientific knowledge, mathematics, teaching of each time and each subject, articulated by the reason of a governmentalized State. Although Pozzobon's thesis is about a training course for high school teachers, we decided to take it into consideration, since it deals with the formation of primary school teachers.

Regarding the thematic dimension Curricular Internship, we bring the thesis of Marquesin (2002). We emphasize that this is the only thesis related to this topic because it is the only one that brings the word in its title. Zimer (2008) and Oliveira (2009) also have the internship as their field of research development.

Marquesin (2012) focused on discussions about initial teacher education, namely the Supervised Internship for Mathematics teaching in primary school in Pedagogy Graduate Courses. The guiding question of the research addresses the necessary knowledge to exercise teaching: "to identify, from a reflective process about teaching rituals and episodes of learning and teaching action to teach mathematics to primary school students, how do training spaces became training places" (p. 27). The theoretical basis of the research was mainly on the studies of Shulman, Nóvoa and Gauthier. In this theoretical framework the Supervised Internship is considered a training space that transforms itself, drawing from the mobilization of teaching knowledge, into a formative place. The author investigated "how do training spaces become places of teaching education and learning and verifies how these spaces/places influence the constitution of teaching professionality and the appropriation of knowledge to teach mathematics" (p. 28). Regarding the teaching of mathematical content, the author concludes that it is important to emphasize that there was consensus among the interns, that to build concepts and the appropriation of related content, students need to communicate their mathematical ideas, which will be valued or questioned from the explanations and validations of the conjectures raised. She also highlights "teaching rituals" because they are unique to the process of teacher education. The research pointed to the importance of supervised internship for the construction of learning conceptions, didactic-pedagogical procedures and professional knowledge for the teaching practice. She also concludes that the training space/place allowed the attribution of meaning and the legitimization of experiences that were testified and observed, as well as influenced the constitution of teaching professionality and the appropriation of knowledge to teach mathematics.

## Final remarks

The descriptive analyzes of the theses show investigations related to the teacher who teaches mathematics, in which the subjects are indeed important and revealing. However, the theses that have as their research question the process itself of the initial training of teachers who teach mathematics in primary school are few, when compared to the number of postgraduate programs in Brazil.

Those that do it, link the issue of Pedagogy Graduate Courses to parallel issues such as emphasis on the process of knowledge constitution, the construction of identity, teaching professionality, the senses, attitudes, visions and conceptions of students, the possible uses of methodological trends, artifacts and formative spaces as influencing elements in teacher education, or the relationship with mathematical knowledge. Thus, we see the following two directions as possibilities for analysis: to analyze beliefs, conceptions, attitudes and values about mathematics and its teaching; pedagogical trends for teacher education.

Regarding the formative processes, the studies elect investigative questions aiming to relate the disciplinary contents particular to teaching with the exercise of pedagogical practice, concluding that the dissociation between both remains. One revealed fact that causes astonishment, although it is known to be real, is the fragility of the mathematical knowledge of Pedagogy undergraduate students.

The theses indicate that the production of knowledge occurs throughout life, regardless of the course being classroom-based or e-learning; knowledge can be built with more foundation if, in the initial education, the experiences of undergraduate students is taken into account and if the curriculum are developed in order to enable learning of teaching knowledge; what meaningful learning related to the practical knowledge of future teachers can be constituted during Pedagogy Graduate Courses.

We have identified theses that have Curricular Internship as an object of investigation, while others take it as a field for investigation of other topics, such as learning of mathematical content, knowledge production, and space for the perception of relationships between learned theory and classroom practice. Another scope of research about the Internship is the methodological perspective in which it takes place, which may be contributory or innocuous in Pedagogy Graduate Courses in the aspect of training for mathematics teaching.

Therefore, we understand that among the conditions for the completion of the initial education of the teacher who teaches mathematics in primary school, it is necessary to consider the institutional conditions during training as significant for the performance and training of the undergraduate student; the pedagogical aspects as fundamental for teacher education; the example of the practices of the teacher educators, the exchange of experiences with classmates and the mathematical content necessary to the teaching practice in primary school.

We realize, however, the lack of studies that emphasize the possible articulations between the mathematical contents and other knowledge that the teacher who teaches mathematics needs in order to teach in the context of primary school. This concern was announced in Oliveira's thesis (2009), which investigated the possibility of using historical artifacts in teaching activities in the mathematics

classroom, emphasizing the teachers' need, in initial training, of mastering the knowledge of mathematical content and knowledge from other fields of study.

We conclude this paper suggesting a reflection about the data presented in the introduction and the result of this systematization. That training for primary school teaching in Pedagogy Graduate Courses is fragile and presents different types of problems is a common sense according to both the official evaluation indexes and the research results. Reflecting on these data and the intervening responsibility of Higher Education Institutions in this scenario regarding Initial Teacher Education is imperative. There are many decades of research in the educational field, both in large scale and in small scenarios, some in focal perspective. Gatti (2009, 2010) highlighted, as was mentioned, the curricular fragility of Pedagogy Graduate Courses. Mindal and Guérios (2013) report how few are the researches that deal specifically with the process of teacher training, while Guérios, Cyrino, Vieira e Melo (2016) identify the same regarding the teacher who teaches mathematics as a focus of study in the Southern Region of Brazil. This research collaborates by focusing on the theses that have the training of the teacher who teaches mathematics in primary school as their focus, and by showing that the plurality of interpretations of the term Teacher Training broadens the investigative spectrum, thus preventing us from having researches that address the essence of the training process in the field of Pedagogy Graduate Courses.

## REFERENCES

ANDRÉ, Marli. Formação de professores: a constituição de um campo de estudos. *Educação*, Porto Alegre, v. 33, n. 3, p. 174-181, 2010.

GATTI, Bernadete. Formação de professores no Brasil: características e problemas. *Educação & Sociedade,* Campinas, v. 31, n. 113, p. 1355-1379, 2010. Retrieved from: http://www.scielo.br/pdf/es/v31n113/16.pdf. Access in: Mar. 20 2019.

_____; BARRETO, Elba. *Professores do Brasil*: impasses e desafios. Brasília, Biblioteca Digital da UNESCO. 2009. Retrieved from: https://unesdoc.unesco.org/ark:/48223/pf0000184682. Access in: Mar. 22 2019.

GUÉRIOS, Ettiène; CYRINO, Márcia; VIEIRA, Anemarie; MELO, Marisol. Mapeamento da pesquisa sobre o professor que ensina matemática: características da Região Sul do Brasil. *In:* FIORENTINI, Dario; PASSOS, Carmen; LIMA, Rosana (Orgs). *Mapeamento da pesquisa acadêmica brasileira sobre o professor que ensina matemática*: período

2001-2012. Campinas: FE/UNICAMP. 2016. p. 43-76. Retrieved from: https://www.fe.unicamp.br/pf-fe/pf/subportais/biblioteca/fev-2017/e-book-mapeamento-pesquisa-pem.pdf. Access in: Mar. 18 2019.

MINDAL, Clara; GUÉRIOS, Ettiène**.** Formação de professores em instituições públicas de ensino superior no Brasil: diversidade de problemas, impasses, dilemas e pontos de tensão. *Educar em Revista,* n. 50, p. 21-33, 2013. Retrieved from: http://www.scielo.br/pdf/er/n50/n50a03.pdf. Access in: Mar. 10 2019.

MOITA, Maria da Conceição. Percurso de formação e de trans-formação. *In:* NÓVOA, Antonio. *Vidas de professores*. Porto, Portugal: Porto Editora, 1995.

PONTE, João Pedro da. Perspectivas de Desenvolvimento Profissional de Professores de Matemática. *In:* PONTE, João Pedro da et al. (Orgs.). *Desenvolvimento profissional dos professores de Matemática:* que formação? Lisboa: Sociedade Portuguesa de Ciências da Educação, Secção de Educação Matemática, 1996.

REVISTA ÉPOCA. *Bernardete Gatti*: "Nossas faculdades não sabem formar professores". Nov. 2016. Retrieved from: http://epoca.globo.com/educacao/noticia/2016/11/bernardete-gatti-nossas-faculdades-nao-sabem-formar-professores.html. Access in: Mar. 10 2019.

## REFERENCES - CORPUS COMPONENT THESES

BUKOWITZ, Natercia De Souza Lima. *Práticas Investigativas em Matemática*: uma Proposta de Trabalho no Curso de Pedagogia. 2005. Tese (Educação) – UFRJ. Rio de Janeiro, 2005.

CARNEIRO, R. F. *Processos formativos em Matemática de alunas-professoras dos anos iniciais em curso a distância de pedagogia*. 2012. Tese (Ensino) – UFSCar. São Carlos, 2012.

FERREIRA, Lúcia Helena Bezerra. *Ateliês de história e pedagogia da matemática*: contribuições para a formação de professores que ensinam matemática nos anos iniciais. 2011. Tese (Educação) – UFRN. Natal, 2011.

GONÇALEZ, Norival. *Atitudes dos alunos do curso de pedagogia com relação* à *disciplina de estatística no laboratório de informática*. 2002. Tese (Educação) – UNICAMP. Campinas, 2002.

MACEDO, Adailson Tavares de. *A teoria de Dienes no ensino de transformação de medidas de comprimento, área e volume no curso de pedagogia*. 2012. Tese (Educação) – UFRN. Natal, 2012.

MARQUESIN, Denise Filomena Bagne. *Os espaços de formação e a constituição da profissionalidade docente:* o estágio e o ensino de Matemática nos anos iniciais do Ensino Fundamental. 2012. Tese (Educação Matemática) – PUC. São Paulo, 2012.

OLIVEIRA, Rosalba Lopes de. *Ensino de Matemática, História de Matemática e Artefatos*: possibilidade de interligar saberes em cursos de formação de professores da Educação Infantil e anos iniciais do Ensino Fundamental. 2009. Tese (Educação) – UFRN. Natal, 2009.

ORTEGA, Eliane Maria Vani. *A construção dos saberes dos estudantes de Pedagogia em relação à Matemática e seu ensino no decorrer da formação inicial*. 2011. Tese (Educação) – USP. São Paulo, 2011.

PALMA, Rute Cristina Domingos da. *A produção de sentidos sobre o aprender e ensinar matemática na formação inicial de professores para a educação infantil e anos iniciais do ensino fundamental.* 2010. Tese (Educação) – UNICAMP. Campinas, 2010.

POZZOBON, Marta Cristina Cezar. *Práticas de ensino de matemática: regimes e jogos de verdade na formação do professor de anos iniciais (1960-2000).* 2012. Tese (Educação) – Unisinos. São Leopoldo, 2012.

RODRIGUES, J. M. S. *A probabilidade como componente curricular na formação matemática inicial de professores polivalentes*. 2011. Tese (Educação) – UFPR. Curitiba, 2011.

SANTOS, Mercedes Bêtta Quintano de Carvalho Pereira dos. *Ensino da matemática em cursos de pedagogia*: a formação do professor polivalente. 2009. Tese (Educação) – PUCSP. São Paulo, 2009.

ZIMER, Tania Teresinha Bruns. *Aprendendo a ensinar matemática nas séries iniciais do ensino fundamental.* 2008. Tese (Educação) – USP. São Paulo, 2008.

Text received on 08/03/2019.
Text approved on 09/18/2019.