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Mathematics Education and pedagogy Courses: progress or inertia?

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Abstract: The aforementioned text presents analyzes of a teacher trainer and is linked to a theorization about the repertoire of knowledge necessary for teaching and follows an opening conference of the VIII National Forum for Initial Training of Teachers who Teach Mathematics (VIII FPMat). This text presents a discussion about Mathematics Education in Pedagogy courses, seeking to identify how Mathematics is present in Pedagogy courses at some public and private institutions in the State of São Paulo. To this end, an analysis of a qualitative nature, of a documentary type, is used, with a view to analyzing the pedagogical projects of the courses, as well as the Teaching Plans. Among the results, it is highlighted that specialized knowledge of the content should be the focus of subjects related to Mathematics in Pedagogy courses and when there are gaps in the common knowledge of mathematical content, this should be deepened. This is a first indication that I would make to the Pedagogy in relation to subjects related to Mathematics and its teaching.

Keywords: Mathematics Education. Pedagogy. Teacher Training.

Educación Matemática y Pedagogía: progreso o inercia?

Resumen: El citado texto presenta análisis de un formador de docentes y se vincula a una teorización sobre el repertorio de conocimientos necesarios para la enseñanza y sigue una conferencia inaugural del VIII Foro Nacional de Formación Inicial de Profesores de Matemáticas (VIII FPMat). Este texto presenta una discusión sobre la Educación Matemática en las carreras de Pedagogía, buscando identificar cómo las Matemáticas están presentes en las carreras de Pedagogía en algunas instituciones públicas y privadas del Estado de São Paulo. Para ello se utiliza un análisis de carácter cualitativo, de tipo documental, con vistas a analizar los proyectos pedagógicos de las carreras, así como los Planes Docentes. Entre los resultados, se destaca que el conocimiento especializado del contenido debe ser el foco de las materias relacionadas con Matemáticas en los cursos de Pedagogía y cuando existen lagunas en el conocimiento común de los contenidos matemáticos, este debe profundizarse. Este es un primer indicio de que. Haría a la Pedagogía en relación con las materias relacionadas con la Matemática y su enseñanza.

Palabras clave: Educación Matemática. Pedagogía. Formación de Professores.

Educação Matemática e os cursos de Pedagogia: avanços ou inércias?

Resumo: O referido texto apresenta análises de uma formadora de professores e articula-se a uma teorização sobre o repertório de conhecimentos necessários para o ensino. Decorre de uma conferência de abertura do VIII Fórum Nacional de Formação Inicial de Professores que Ensinam Matemática (VIII FPMat). Este estudo expõe uma discussão sobre a Educação Matemática nos cursos de Pedagogia, buscando identificar como a Matemática se faz presente nos cursos de Pedagogia de algumas instituições públicas e privadas do Estado de São Paulo. Para tanto, recorre-se a uma análise de natureza qualitativa, de tipologia documental, tendo em vista a análise dos projetos pedagógicos dos cursos, bem como dos Planos de Ensino. Dentre

os resultados, destaca-se que o conhecimento especializado do conteúdo, no sentido de Ball, Thames e Phelps (2008), deve ser foco das disciplinas relativas à Matemática nos cursos de Pedagogia e, quando houver lacunas no conhecimento comum do conteúdo matemático, este deve ser aprofundado. Essa constatação é uma das principais indicações decorrentes de pesquisas da autora deste texto, possível de ser atendida nos cursos de Pedagogia em relação às disciplinas que se relacionam à Matemática e seu ensino.

Palavras-chave: Educação Matemática. Pedagogia. Formação Inicial de Professores.

1 Introduction

This text is the result of the author's participation as one of the speakers in the opening panel of the VIII National Forum for the Initial Training of Professors who Teach Mathematics (VIII FPMat), entitled *Public Policies and the Training of Professors who Teach Mathematics*. The invitation stemmed from the author's participation in the WG1 Mathematics in Early Childhood Education and in the Early Years of Elementary School of the Brazilian Society of Mathematics Education and, in particular, from the research she has carried out in recent years on mathematics education in pedagogy courses.

The problem of the conference was guided by the question: what knowledge for the teaching of mathematics should the Pedagogy course offer to future professors who have a comprehensive high school education, who have never experienced the profession and who, in general, seek this type of course for reasons that are not always academic?

When the Pedagogy course was introduced in Brazil in the 1930s, its purpose was to train educators, managers, and professors for teaching courses. Its curricular structure, although modified over the years according to legislation, still reflects its original objectives.

The National Law of Educational Guidelines and Foundations — LDBEN 5.692/71 (Brazil, 1971) gave professors the opportunity to take pedagogy courses after completing a high school teaching course. According to Curi (2005), at that time, the pedagogy course had a common core of general training with subjects such as sociology, philosophy, history of education, psychology, and another core of specific training, depending on the student's choice. In the teaching qualification, the subjects were structure and function of primary education, primary methodology and teaching practice in primary schools. As you can see, this legislation did not have a grid focusing on the subjects to be taught in the early years. Curi (2005) points out that the purpose of the course was not to train teachers to work in the early years, but rather to train educators or teachers to be trained in high school teaching courses. With the new Law on the Guidelines and Bases of National Education — LDBEN 9.394/96 (Brazil, 1996), changes were proposed for courses to train professors for the early years.

Curi's doctoral thesis (2004) was part of these proposed changes. At that time, the National Guidelines for Pedagogy Courses were being structured. At the same time, there was an indication at the federal level that the training of teachers in the early years should be carried out in the Higher Normal Course, with a different structure from the pedagogy courses and with a focus on the training of professors. This idea was not accepted due to pressure from associations and universities, which saw the Higher Normal Course as a less academic course, with fewer requirements, and one that could lead to the emptying of the pedagogy courses.

It is worth noting that in 2003, the São Paulo State Department of Education It is worth noting that in 2003, the São Paulo State Department of Education closed the training courses for generalist teachers (the nomenclature used to refer to professors working in the early years

of elementary school) at the secondary level, in teaching courses, and demanded that this training be mandatory at the university level, preferably in a pedagogy course.

In light of these considerations, this text discusses mathematics education in pedagogy courses, seeking to identify how mathematics is present in these courses in some public and private institutions in the State of São Paulo. To do this, we used a qualitative analysis of a documentary nature, analyzing the pedagogical projects of the courses, as well as the teaching plans. Specifically, the text is based on research carried out over the years (references), as well as the author's experience in the pedagogy course and in the development of research projects aimed at professors in the first years.

This text is divided into sections. The first section discusses the pedagogy course. The second section discusses the professor's knowledge of how to teach mathematics. The third section presents a more recent overview of the data collected by the research group *Knowledge, Beliefs, and Practices of Professors Who Teach Mathematics*, coordinated by the author of this text.

2 The pedagogy course

LDBEN 9.394/96 established the training of early childhood teachers at the university level. However, the regulations for this training were not presented until 2002 by the National Education Council, through Resolution CNE/CP 1 of February 18, 2002 (Brasil, 2002), which established the Curricular Guidelines for Teacher Training in Pedagogy or Higher Normal Courses. These guidelines propose that educational institutions create a pedagogical project based on the competencies needed to become a teacher, and article 6 describes the nature of these competencies. These include competences related to the mastery of the content to be socialized, its meaning in different contexts, its interdisciplinary articulation and competences related to the mastery of pedagogical knowledge. The document also emphasizes that the set of competences described should be complemented by those specific to the stage of basic education in which the professor will work (early childhood education and the first years of primary education).

In Article 11, the Guidelines emphasize a concern with the objects of knowledge to be taught at each stage of schooling. Although these guidelines were presented in 2002, the research carried out in Curi's (2004) thesis predates them, as it was carried out in 2002 and there was no time for educational institutions to incorporate the proposed changes. In this sense, in order to understand what was being discussed in pedagogy courses to teach mathematics, in 2002, Curi analyzed the subjects related to mathematics and its teaching in 36 courses located in different Brazilian states, which at that time published syllabi and menus on the Internet and which had reformulated the course from the year 2000, therefore after LDBEN 9. 394/96 (Brazil, 1996). Closed the training courses for generalist teachers (the nomenclature used to refer to professors working in the early years of elementary school) at the secondary level, in teaching courses, and demanded that this training be mandatory at the higher education level, preferably in a pedagogy course.

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In the institutions analyzed, the workload of the subjects related to mathematics was around 36 to 72 hours, less than 4% of the total 2,200 hours of the course. It is worth noting that about 90% of the courses had subjects focused on the methodology of teaching mathematics, and of these, 65% focused on reviewing the mathematical content of the last years of elementary school, such as *fractions* and *relative* numbers, without taking into account the topics of measurement and geometry, which were included in the curricular proposals for teaching mathematics in the first years of elementary school.

In the State of São Paulo, the focus of this text, at that time, there was the Mathematics Curriculum Proposal for the First Grade (8 years of education), which put a lot of emphasis on the subject of measures with an integrating axis between numbers and geometry and the study of geometric shapes, starting with spatial figures and then flat figures, and this was not contemplated in the training of pedagogues, according to the curricula analyzed by Curi (2004).

The other 10% of the courses analyzed had only one mathematical subject, statistics. The inheritance of the subject of statistics in pedagogy courses comes from the institution of these courses that had this subject, because at that time it was the professor who worked in the first years, who made reports presenting statistics of the vaccination of children carried out in schools and of the eye examinations also carried out in schools.

A more detailed analysis of the curricula analyzed in Curi (2004) showed that the most common subjects were the teaching of numbers and the four operations with natural numbers. In some of the institutions analyzed, it was noticeable that the content normally indicated for the last years of elementary school was reviewed, prioritizing natural, rational and whole numbers.

An important analysis that allows us to infer the conceptions of the subject in this course is that of the bibliographical references. The references found were related to authors who discussed more general didactics. In some institutions, there were some references to texts in the field of mathematics education, such as Constance Kamii's *The Construction of Number by Children.*

The teaching strategies most frequently mentioned in the syllabi of the courses analyzed by Curi (2004) were lectures and reading groups, and the most frequently mentioned resources

[1] Data collected for Curi's doctoral thesis (2004).

were chalkboards, lists of exercises, teaching materials and games. Some syllabi included the use of Golden Material and the Cuisenaire Scale. As can be seen, the focus of the references presented was on general methodological knowledge, such as the use of folded posters, flannel graphs, games, among other artifacts more oriented towards the teaching of mathematics, and very rarely did the use of Golden Material and the Cuisenaire Scale appear.

It is worth noting that since the publication of the Mathematics Curriculum Proposal in the early 1990s, the State of São Paulo had proposed the use of the Golden Material and the Cuisenaire Scale, which were purchased and distributed to all public schools in the state network. There were also courses to train professors in the use of these materials, but this was not yet included in the syllabi of the courses analyzed.

For the analysis of the pedagogy courses, we turned to the work of Gatti (2009, 2012). Gatti (2012) discusses the Pedagogy course over time and points out that it does not have its own identity. In addition, Gatti and Nunes (2009) analyzed some curricular proposals for Pedagogy courses, but without the focus on mathematics presented by Curi (2004). These studies show that there is great diversity in the curricula of these proposals, but that in all of them there is an excessive number of subjects and, consequently, curricular fragmentation. In another study, Gatti (2012) draws attention to the predominance of generic training that does not reflect the relationship between theory and practice, focusing on the legislation for the training of professors for undergraduate education. Apparently, Gatti points out that, despite all the specific legislation for pedagogy courses, little has changed since Curi's (2005) research almost ten years earlier.

Another author who presents an analysis of the curricula of pedagogy courses with a focus on mathematics is Alencar (2018). She analyzed the curricula of 20 Brazilian Pedagogy courses, as well as some from Chile, Argentina, Portugal, Spain, and Mexico that participated in the International Observatory project. In the courses in Brazil, the average number of subjects related to mathematics and its teaching is between 60 and 72 hours. In the other countries analyzed, the average is between 130 and 150 hours, indicating a greater number of hours devoted to training for teaching mathematics.

Alencar (2018), like Curi (2005), found that subjects related to the teaching of mathematics are silenced. According to the author, in some institutions there are no required subjects that discuss the teaching of mathematics, only optional subjects. Alencar (2018) divided the subjects into two categories. In the first, she grouped those related to the didactics and/or methodology of teaching mathematics, identifying the majority of courses with different names in the disciplines, but focused on the teaching of mathematics in the early years. In the second, the author mentions more mathematical subjects, such as statistics, and a greater concern with knowledge of mathematical content for the training of professors than with didactics.

Based on these historical reviews, I would like to highlight some aspects that can inform discussions about the initial training of professors to work with children in the early years of primary school:

- The silencing of subjects aimed at teaching mathematics, because the courses were more comprehensive, and when there was mathematical content in the training courses, it was related to arithmetic, especially numbers and the four operations;
- The review nature of mathematical knowledge, without in-depth study of concepts or mathematical language;

- The silencing of mathematical knowledge, which can lead to the reflection that in order to teach mathematics, it is not necessary to know specific mathematics, since it is enough to know how to teach it;
- The lost paradigm highlighted by Shulman (1992), who emphasized that the training of professors focuses less on teaching objects than on teaching methods;
- The low impact of mathematics education research in the bibliographies of pedagogy courses;
- The linear organization of mathematical knowledge to the detriment of curricular organization in a spiral or network of knowledge;
- The lack of diversity in teaching strategies, which focus more on lectures and less on investigative activities and problem-solving;
- The dissociation between mathematical knowledge and didactic knowledge;
- The lack of discussion about mathematics curricula.

In conclusion, I would like to point out that the researches cited in this text, since 2004, have shown that the time allocated to the initial training of teachers to work in the early years has always been scarce, but more than that, there have been possible gaps in the mathematical knowledge of future professors and the discussions have been limited, with more emphasis on topics of a didactic and methodological nature, without reference to the curricula of the early years and without a focus on theoretical foundations and research in the field of mathematics education.

And today, has progress been made?

We'll see in the next section. First, however, I will present some aspects of the repertoire of knowledge for teaching mathematics.

3 The professor's knowledge for teaching mathematics

In order to analyze the data collected, I returned to the studies of Shulman (1986, 1987) and referred to the three strands of professorial knowledge mentioned in the author's first texts: content knowledge, didactic content knowledge, and curriculum knowledge. Although we know that there are other types of knowledge involved and that the three strands mentioned are interwoven in the professor's practice, broken down, they are very enlightening for rethinking teacher education.

There are also studies by Ball, Thames, and Phelps (2008) that propose an approach to the study of mathematical knowledge for teaching based on studies by Shulman (1986). The authors go into more detail, emphasizing specialized content knowledge and distinguishing it from general content knowledge, two fundamental aspects of professorial training. Below, I will highlight some types of content identified by these researchers that are relevant to this article.

Common Content Knowledge refers to knowledge that is not exclusive to professors, as other professionals also have mastery of this type of knowledge. In this sense, for example, a professional who knows the concept of proportionality and uses it to build a bridge does not have the specific knowledge of this concept to teach it. The authors believe that the professor must have this general knowledge *for his own use* of the content, but that this knowledge must go beyond this in order to be taught.

Specialized Content Knowledge refers to knowledge specific to teaching that helps professors identify patterns in students' errors, which allows them to analyze the procedures and strategies used by students and see if it is possible to construct a generalization. Ball, Thames e Phelps (2008) point out those recognizing errors is general content knowledge, but thinking about the nature of those errors, understanding their patterns, and reflecting on their meanings is part of specialized content knowledge.

For Ball, Thames e Phelps (2008), content and pedagogical knowledge relates specific mathematical knowledge to pedagogical knowledge. To teach a particular piece of content, professors often use instructional sequences, choose examples that allow students to make approximations to content they already know, and define or choose questions or problems that allow them to go deeper. Professors also make choices about the representations they use to develop content, evaluating the potential of some representations over others, which implies knowledge of the mathematical content to be developed and the methodological procedures that can contribute to student learning.

In this sense, the professor will be able to decide which questions to highlight and discuss at that moment, which to ignore, which to answer later, or when to interrupt his or her presentation to clarify something that will be crucial for the students' understanding, or even to ask a new question that will help to make more sense of the content being discussed. In order to do this, it is very important for the professor to be clear about the objective being addressed, the different ways in which that content can be conveyed, and the importance of examples and counter-examples.

Content and Curriculum Knowledge is the confluence of knowledge that allows the professor to understand the organization, goals, principles, and development of the curriculum, which enables the analysis of curriculum materials to make assertive decisions and how to use them in their teaching proposal.

Curi (2004) highlighted the need for professors to *appropriate* some mathematical content for teaching. As one of the results, the study showed that when professors had little knowledge of the mathematical content they had to teach, they showed insecurity when faced with teaching situations involving this content, often failing to carry out activities suggested in textbooks.

However, which knowledge for teaching should be privileged in the pedagogy course? For this reflection, we highlight some data from the current research on pedagogy courses carried out by the CCPPM group.

4 Some current research data

As announced, this text includes qualitative research of a documentary nature, which is presented as a proposal that allows imagination and creativity and leads researchers to develop studies that explore new approaches (Godoy, 1995). In this sense, we recognize and agree with the author when she states that qualitative research of a documentary nature represents a rich source of data and deserves special attention due to its innovative nature, which will bring important contributions to our study of mathematics education in the pedagogy course. According to Godoy (1995), the word *documents*, in the case of research, should be understood in a broad sense, including the different types of written materials. Therefore, in our study, as announced, we chose the following as documents: Pedagogical Course Projects (PPCs) and Curricula of Pedagogy Courses from some public and private educational institutions in the State of São Paulo.

In defining the *corpus* of analysis, the CCPPM research group, led by the author of this text, organized a survey of Pedagogical Course Projects (PCPs) and Curricula of Pedagogy courses in some public and private educational institutions in the State of São Paulo. Thus, each member was responsible for obtaining data from two educational institutions that they were close to, either because they had studied pedagogy in that institution or because they lived nearby. Once this stage was organized, the members tried to obtain the documents in two ways: directly from the websites of the institutions or by requesting them from the course coordinators by letter. There were many difficulties with the second method because many course coordinators did not respond.

After collecting the data, the group made a first reading of the document and prepared summaries. To do this, some aspects guided the researchers: *the workload of the subjects that refer to mathematics education and their respective curricula*; the presence of extension subjects and their workload; in the subjects called internships and teaching practices, is there any reference to mathematics education? *The profile of the professor in charge of the subject's syllabus; the mathematical content covered in the syllabus; the presence or absence of mathematical processes (problem-solving, investigative activities, modeling); the reference to the basic ideas of mathematics and mathematical literacy; the identification in the references of whom the theorists are, whether they are from mathematics education or cover more general topics in education; the presence of the National Common Curriculum Base (BNCC).* However, in this text we will not focus on the presence of extension disciplines and their workload, nor on the disciplines related to internships, teaching residencies and teaching practices.

The *corpus* of analysis in this text consists of seven Pedagogical Course Projects (PPCs) and their respective curricula from Higher Education Institutions (HEIs) in the State of São Paulo, two public and five private.

Chart 1: Analysis corpus

Institution[2]	Subject	WL
MA	Theoretical Foundations of Mathematics Teaching	63,33
	Mathematics teaching and didactic specificities	63,33
NA	Learning Mathematics	30
FM	Mathematics Methodology and Practice in Early Childhood Education	66
	Methodology and Practice of Mathematics in Literacy	66
	Mathematics Methodology and Practice in the Early Years of Primary Education	66
SJ	Mathematical education: the construction of mathematical knowledge and practice (includes 40 hours of Teaching Practices)	160h

[2] In an attempt to maintain the anonymity of the institutions, we have established codes.

UNIF	Theoretical and practical foundations for teaching mathematics I	75
	Theoretical and practical foundations for teaching mathematics II	
VESP	Mathematics Education	40
	Foundations and practices in the teaching of Mathematics	80
	Supervised Internship in Mathematics and Sciences in Primary School I	50
UCS	Foundations and Methodology of Mathematics Teaching	60

Source: survey carried out by the CCPPM Research Group

As can be seen in this study, the subjects have different names, but most of them mention methodology, practice, and foundations in math teaching. It was also noted that one of the institutions has a course on Supervised Curricular Internships in Mathematics in its curriculum, which may reveal an advance on the courses at other institutions.

In terms of subject hours, they vary from 30 to 180 hours. The AN institution offers a single 30-hour course, which is considered impossible to cover the knowledge needed to teach this curricular component. On the other hand, the SJ institution has 160 hours earmarked for Mathematics Teaching, but 40 hours are earmarked for Teaching Practice. So the question is what is being developed in these hours allocated to practice?

With regard to the profile of the teacher who is responsible for the Teaching Plan, it can be seen that the majority do not inform who is responsible, but of the institutions to which the group had access, one has a degree in Mathematics (UCS) and a doctorate in Mathematics Education, as well as working in research, teaching and extension, and the other professor (UCS) has a degree in Mathematics and a master's degree in Production Engineering.

With this data, it is possible to reiterate what was already shown in the research by Curi (2011), that if the professor responsible for subjects related to mathematics teaching is not a mathematics educator, and has a generalist background, they run the risk of developing their classes in a more general way, without a focus on mathematical and didactic knowledge. Often, teachers' lack of experience in the early years of elementary school leads them to be unaware of the up-to-date curriculum for this segment of education, especially when there are curriculum changes. More recent studies, such as Martins, Nacarato and Moretti (2023), defend the profile of the Pedagogy course teacher:

> be a mathematical educator, understood as: having a degree in mathematics and being involved in the training of teachers who work at the levels of education - Early Childhood Education and Early Years of Elementary Education; or being involved in research in these teaching segments and having knowledge of their educational reality; or being a Pedagogue, with mathematical knowledge coming from insertion in research in Mathematics Education or in the training of professors who teach Mathematics (Martins et al., 2023, p.88).

In relation to the MA institution, the syllabus for the subject *Theoretical Foundations of Mathematics Teaching* mentions early childhood education, but there is no theoretical reference in the basic and complementary bibliographies. Regarding the specific and pedagogical knowledge of the content, the syllabus refers to the thematic unit numbers, but with an emphasis on natural numbers; it mentions algebra and the development of algebraic thinking, but says that it is in the context of teaching operations, and finally it refers to the teaching of geometry. As for the basic bibliography, the group found that there is only one reference to the teaching of geometry, ignoring the fact that, although there is a prescription for other thematic units such as algebra and numbers, there are no theoretical references. The constant references refer to discussions about the teaching of mathematics in a broader sense. The group also noticed a silence in relation to the thematic units Quantities and Measures and Probability and Statistics. In terms of curricular knowledge, curricular references such as the PNAIC were identified, but the absence of the BNCC in the curriculum. With regard to the second subject *Teaching Mathematics: didactic specifics*, the group noted that it was a continuation of the previous subject, since in the case of the thematic unit on numbers, there was an extension to rational numbers, as well as a focus on the multiplicative field. In the syllabus, the thematic units have also been expanded, with the addition of Quantities and Measures and, as noted, *Treatment of Information*, an outdated nomenclature in relation to the BNCC, which refers to Probability and Statistics. In the analysis, the group found that the same basic and supplementary bibliographies were used as in the previous subject. Therefore, in this plan, what is in the syllabus does not match the theoretical indications. In addition, the group pointed out that the study of additive field problems is not even mentioned, instead focusing on multiplicative field problems.

Regarding the AN institution, the only subject is Learning Mathematics, whose syllabus mentions the history of mathematics in Brazil, the teaching and learning process of all thematic units in line with the BNCC (Brazil, 2017), and refers to trends in mathematics education, without specifying which ones, and the concept of interdisciplinary. However, the basic and complementary bibliographies do not focus on general mathematics education or playfulness. There is not even a reference to specific content and curriculum knowledge.

With regard to the FM institution, the group was unable to access the plans. The curriculum for the subject *Methodology and practice of mathematics in early childhood education* focuses on the constructive nature of logical-mathematical knowledge and the study of the psychogenesis of elementary logical structures, spontaneous geometric structures and number, as well as on the spontaneous graphic representation of quantity and the child's learning of numerical notation in their interaction in different social practices. The subject *Methodology and practice of mathematics in literacy* covers the conceptual and methodological dimensions of teaching mathematics in relation to numbers and operations, space and shape, measurement and information processing at this stage of schooling, i.e., it still uses the same nomenclatures as the PCN in relation to thematic blocks (Thematic Units). The last theme, *Methodology and practice of mathematics in the early years of primary education*, although it mentions algebraic thinking, uses the wrong nomenclature: numbers and operations, information processing and statistics, geometry, algebraic thinking and systems of measurement. It is worth noting that the PPC does not even include basic and supplementary bibliographies. Therefore, there is no evidence of which teaching skills are covered.

In the SJ institution, the subject *Mathematical Education: the construction of mathematical knowledge and practice* mentions the basic ideas of mathematics, such as equivalence, order, proportionality, interdependence, representation, variation, approximation,

and all the thematic units of the BNCC (Brazil, 2017), i.e., numbers, geometry, algebra, quantities and measures, and probability and statistics, as well as the mention of games and projects But the PPC does not explain the basic and supplementary bibliographies either.

With respect to the UNIF institution, the syllabus for the subject *Theoretical and Practical Foundations for the Teaching of Mathematics I* focuses on the teaching of mathematics in early childhood education and in the early years of primary education, based on an understanding of mathematics as a historical human production.

It covers the basic concepts of the field, elements of the history of its development, and different theoretical and methodological approaches to its teaching. The basic bibliography contains references to the basic concepts of mathematics and research on numbers in the field of mathematics education. The complementary bibliography refers to the BNCC (Brazil, 2017) and other references related to the teaching of mathematics in early childhood education and the first years of primary education. In the subject *Theoretical and Practical Foundations for Teaching Mathematics II*, the syllabus already states that it is a continuation of the previous subject, but geometry and information processing are highlighted. We also noticed that some nomenclature is old, as well as the absence of algebraic thinking and quantities and measures. The basic and complementary bibliographies show evidence of specific, pedagogical and curricular knowledge, but with the latter, they still show old indications (Brasil. Secretariat of Basic Education. National Curriculum Parameters: Mathematics.

As far as the VESP institution is concerned, in the curriculum of the subject *Mathematics Education*, the institution prioritizes the theoretical-practical knowledge necessary to work with mathematics in elementary school, which shows the exercise of reflection-action-reflection and the construction of autonomy. However, the bibliographies mention the history of mathematics and the methodology of teaching mathematics. Although they refer to the concepts of reflection-action-reflection, there is not even a reference to the texts of Donald Schön, a specialist in this field. Regarding the topic *Foundations and Practices in the Teaching of Mathematics*, the curriculum states Foundations focuses on the teaching of mathematics in elementary and secondary schools. However, the pedagogy course qualifies professionals to work in early childhood education and in the early years of primary education, not secondary education, which reveals a misconception. The undergraduate and graduate bibliographies focus on the foundations of mathematics, the philosophy of mathematics, and the teaching of mathematics in general. In terms of specific content knowledge, we found only one reference to the teaching of geometry. Finally, in the subject *Supervised Internship in Mathematics and Science in Primary School I*, the syllabus aims to encourage the student to acquire an overview of the discussion about the social function of teaching mathematics and science in early childhood education and the early years. In the basic and supplementary bibliographies, we see that the references are more pedagogical and only one refers to problem-solving.

In the case of the UCS educational institution, the subject *Fundamentals and Methodology of Teaching Mathematics* presents in its syllabus studies on mathematics in early childhood education: mathematical concepts; pre-numerical activities; numbers; quantities; spaces; counting; numerical notation and writing; and studies on the teaching of mathematics in the early years of primary education and in the EJA: quantities, counting, measures, calculation techniques and their contribution to the development of logical thinking, the ability to abstract, generalize and project. The curriculum presents the teaching of mathematics comprehensively, focusing on numbers and computational techniques. It is silent on the thematic units of probability and statistics and algebra. We found only three basic references,

one of which focuses on geometry, one on numbers, and one on teaching mathematics. Therefore, for the other Thematic Units, such as Algebra, Quantities and Measures, there are no theoretical references listed in the bibliographies. In the complementary reference, there is an indication of the BNCC (Brazil, 2017), on the use of digital artifacts (calculators) and on problem-solving. Despite the fact that the curriculum includes reflections on mathematics in early childhood education, the group did not find any references to this level of education in the bibliographies.

In summary, although some institutions have two or three subjects related to the teaching of mathematics in the pedagogy course, or even allocate 160 hours to this curricular component, the subjects in the same course and in the same institution do not interact with each other, which is why no progress has been made; For example, the institution that focuses on teaching multiplicative field problems in subject 2 without including additive field problems in the first syllabus, or the institution that provides continuity in the three subjects of the course related to mathematics teaching but does not change the basic and complementary bibliographies. In addition, it was possible to observe that the syllabi do not dialogue with the basic and complementary bibliographies and that there is a silencing of the mathematical processes that are highlighted in the BNCC (Brazil, 2017) as privileged forms of mathematical activities, such as problem-solving, investigation, project development and modeling. The fundamental ideas of mathematics are mentioned in a single syllabus, but without references that can help expand knowledge.

In general, based on the courses analyzed, it is possible to conclude that there has been no progress in relation to the scenario pointed out earlier in this text:

- Little presence of subjects aimed at teaching Mathematics, with a greater emphasis on the Thematic Units Numbers and Geometry. In some plans, the Thematic Units of Quantities and Measures, as well as Probability and Statistics, were silenced;
- reinforcement of the idea that in order to teach mathematics, you don't need to know specific mathematics, since it's enough to know how to teach it.
- Little emphasis on mathematical processes (investigation, problem-solving, modeling, fundamental ideas);
- lack of research in the area of Mathematics Education in the basic and complementary references;
- lack of discussions about mathematics curricula, including the syllabuses using the nomenclature prioritized in the PCNs (1987) to the detriment of the more current nomenclature highlighted in the BNCC (2017); and
- Silence about the BNCC (Brazil, 2017).

In summary, the research carried out by the CCPPM group corroborates some considerations already highlighted in this text: there are few hours allocated to the subject of Mathematics and its teaching in some of the courses analyzed, but this is not the main problem in Pedagogy courses. The current research reveals problems with the focus given to these subjects and the lack of incorporation of research in the area of Mathematics Education in the bibliographical references, despite all the progress in the area, the number of stricto sensu courses and publications on the teaching of mathematics and the training of professors.

The data presented so far suggests that the curricula of teacher training courses should be updated and adjusted to meet the demands and challenges of contemporary education. This includes conditions for professors in training, and during their induction period, to build basic knowledge in mathematics. There are various types of professional knowledge required for teaching, among which the following are some that are considered essential, in the belief that they are more important than reviewing a list of mathematical contents, which do not always include what is proposed by curriculum documents to be taught in the early years, since training time should be much longer for this purpose. Thus, among the essential knowledge for the Pedagogy course, knowledge stands out:

- The teaching objects planned to be taught in the Early Years of Primary School, in greater depth, their mathematical nature, their historicity, their articulations, their internal organization, among other aspects;
- The articulation of what will be taught with other knowledge already built up by the children, contextualizing it in situations of interest and with other areas;
- The didactic nature of the content interwoven with common and specialized content knowledge and curricular knowledge;
- The mathematical procedures and representations related to each other and used in different contents;
- Doing mathematics (problem solving, investigative activities, identifying hypotheses, argumentation, mathematical communication);
- The fundamental ideas of mathematics present in the curriculum and the diversity of mathematical reasoning that needs to be developed at school;
- And an understanding of how children learn mathematical concepts;
- The process of planning teaching, how to organize routines and use instructional resources, analyze and propose tasks appropriate to the object of teaching and the grade;
- The role of mathematics in today's world, as a tool for understanding and interpreting the world and as an area of knowledge.

In this sense, we can see that there is a lot to be done in pedagogy programs, in both research and practice, and that there are many challenges ahead if we want to promote quality initial education. It is necessary to create conditions so that future professors who will teach mathematics in the early years have the specific knowledge of mathematics to teach it, incorporating research results in the field of mathematics education. In general, research in mathematics education is little known to future professors. This fact reinforces the existence of a dichotomy between teaching and research activities in higher education institutions.

5 Some reflections

In conclusion, it should be noted that the research carried out by Curi (2004, 2005), which has been extended over the years, and that of other researchers, such as Gatti (2012) and Alencar (2018), point to gaps in the knowledge of mathematics teaching in the training of professors in pedagogy courses, with discussions limited to arithmetic, to general issues of a didactic, and methodological nature, without reference to the curricula of the first years and without focusing on theoretical foundations and research in the field of mathematics teaching.

As already mentioned, it should be emphasized that today the Pedagogy course is the

only one that trains professors to work in the early years of primary school; therefore, there is an urgent need for this course to have clear objectives in the constitution of knowledge to be taught.

It is necessary to dispel the common-sense myth that the mathematics to be taught and learned by children in the early years is reduced to the four operations, that these contents are the domain of the literate population, and that therefore *anyone with common sense* can teach them. In other words, anyone with common knowledge of certain content can teach it, they just need to know how? However, as this text has shown, there is a big difference between the general knowledge a person has about a certain subject and the knowledge he/she needs to have about this subject in order to teach it.

In conclusion, we believe that specialized knowledge of the content should be the focus of the subjects related to Mathematics in Pedagogy courses and when there are gaps in the common knowledge of the mathematical content, this should be deepened. This is an important indication for Pedagogy courses in relation to subjects related to Mathematics and its teaching, rather than organizing the subject related to Mathematics into a list of *contents similar to the index of a Mathematics textbook for the final years of Primary School.*

It is important to emphasize the importance of considering the influence of beliefs, conceptions, attitudes, and myths about mathematics and its teaching on professors' practices. It is important to remember that the professor is the only professional who studies in an environment (the school), who will act professionally in the same environment (the school), and that this fact can lead to very strong influences of what they have studied and how they have studied on their practice. In this sense, another challenge in initial teacher education is undoubtedly to think about how to incorporate the experiential knowledge of future teachers so that they can reflect on the relationship between this knowledge and the profession. In this sense, the internship and the pedagogical residency play a fundamental role and will be discussed on another occasion.

Finally, it should be noted that although the syllabus of the pedagogy course includes the content of the BNCC (Brazil, 2017), the number of hours is insufficient to cover all the content prescribed for teaching mathematics in the early years of primary school. Therefore, the syllabus needs to focus on a repertoire of knowledge for *knowing and doing* mathematics in the Early Years of Primary School.

References

Alencar, E. S. (2018). A formação do pedagogo para o ensino de matemática em instituições do observatório internacional. In: *Anais do 7º Seminário Internacional de Pesquisa em Educação Matemática* (pp. 1-12). Foz de Iguaçu, PR.

Ball, D. L., Thames, M. H. & Phelps, G. (2008). Content Knowledge for Teaching: what makes it special? *Journal of Teacher Education, 59*(5), 389-407.

Brasil. Câmara dos Deputados. (1971). *Lei n. 5.692, de 11 de agosto de 1971*. Fixa Diretrizes e Bases para o ensino de 1º e 2º graus e dá outras providências. Brasília, DF: Diário Oficial da União, 12 ago. 1971.

Brasil. Conselho Nacional de Educação (2002). *Resolução CNE/CP n. 1*, de 18 de fevereiro de 2002. Institui as Diretrizes Curriculares Nacionais para a Formação de Professores da Educação Básica. Brasília, DF: Diário Oficial da União, 4 mar. 2002.

Brasil. Conselho Nacional da Educação. (2006). *Resolução CNE/CP n. 1, de 15 de maio de*

2006. Institui Diretrizes Curriculares Nacionais para Cursos de Graduação em Pedagogia Licenciatura. Brasília, DF: Diário Oficial da União, 16 maio 2006.

Brasil. Ministério da Educação. Secretaria de Educação Básica. (2017). *Base Nacional Comum Curricular: Educação Infantil e Ensino Fundamental.* Brasília, DF: MEC/SEB.

Brasil. Ministério da Educação. (1996). *Lei n.* n. 9.394, de 20 de dezembro de 1996. Estabelece as diretrizes e bases da educação nacional, n. 9.394/1996. Brasília, DF: Diário Oficial União, 23 dez. 1996.

Curi, E. (2005). *A matemática e os professores dos anos iniciais.* São Paulo, SP: Musa.

Fiorentini, D., Nacarato, A. M., Ferreira, A. C., Lopes, C. S., Freitas, M. T. & Miskulin, R. G. S. (2002). Formação de professores que ensinam matemática: um balanço de 25 anos de pesquisa brasileira. *Educação em Revista*, *36*, 137-160.

Gatti, B. A. (2012). O curso de licenciatura em pedagogia: dilemas e convergências. *EntreVer*, *2*(3), 151-169.

Gatti, B. A. & Nunes, M. M. R. (Org.). (2009). *Formação de professores para o Ensino Fundamental: estudo de currículos das licenciaturas em Pedagogia, Língua Portuguesa, Matemática e Ciências Biológicas.* São Paulo, SP: Fundação Carlos Chagas.

Godoy, A. S. (1995). Pesquisa qualitativa: tipos fundamentais. *Revista de Administração de Empresas*, *3*(35), 20-29.

Martins, P. B., Nacarato, A. M. & Moretti, V. D. (2023). Educação Matemática na Licenciatura em Pedagogia. *Revista de Educação Matemática*, 20, 1-15.

Shulman, L. S. (1986). Those who understand: knowledge growth in teaching. *Educacional Research*, *2*(15), 4-14.

Shulman, L. S. (1987). Knowledge and teaching: foundation of the new reform. *Harvard Educational Review*, *57*, 1-22.