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STATE OF THE ART OF DISSERTATION PRODUCTIONS IN THE PROFESSIONAL MASTER'S PROGRAM IN MATHEMATICS IN THE NATIONAL NETWORK THAT DEALS WITH TEACHER TRAINING, FROM 2012 ONWARDS

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ABSTRACT

This work seeks to show the production of works with a theme in mathematics education in the Professional Master's program in Mathematics in the National Network that deal with teacher training, from 2012 onwards. In the construction of the scenario of this research, we collected data through the keywords Teacher Training and Continuing Education on the PROFMAT Portal. After the survey of the dissertations, the distribution and comparison by regions of the country was made, and an analysis of the current situation of these productions within this program was made. In this work, we present the difficulty of the program in enabling the production of research on the theme of teacher training and the rigid line of research present in the Professional Master's Degree in Mathematics in the National Network – PROFMAT.

Keywords: State of the art, Mathematics Education, Teacher Training, Profmat.

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INTRODUCTION

The search for the construction of the real scenario on teacher training in the country is a constant source of discussions in education meetings, seminars, research groups, forums, theses and dissertations. The growth in access to higher education courses and the greater offer of courses made it possible to improve teacher training and increase the search for postgraduate courses in the area of education. According to data from the National Institute of Educational Studies and Research Anísio Teixeira (Inep), in the Microdata of the 2020 Higher Education Census, in Brazil, there were 477 face-to-face teacher training courses in Mathematics, responsible for the training of more than 60 thousand professionals per year. On the other hand, the low quality of these undergraduate courses, proven in the results of the undergraduates who take the National Course Exam, who obtained an average of 2.2 on a scale ranging from 0 to 10, and in the high dropout rate in the courses, point to an urgent restructuring of the undergraduate courses and continuing education of professionals who teach mathematics.

From Resolution 02/2019, supported by CNE/CP Opinion No. 22/2019, which established parameters for initial and continuing teacher training from the perspective of knowledge, practice, and engagement, issues regarding practice, didactics, specific knowledge, legal issues, and the pedagogical projects of the degree courses, came to the fore of studies, such as COSTA AND MATTOS (2021) AND ALVES AND DUARTE (2022), seeking to understand the consequences of these changes and their reflections on teacher training and their pedagogical practices.

Allied to this resolution, the National Curriculum Guidelines, regulated by Law 9394/96, already directed Higher Education Institutions (HEIs) to analyze the curricular structuring of teacher training courses followed by Decree 9,235 of 2017 determining that they have institutionalized extension programs as a form of authorization for reaccreditation as universities or university centers.

One of the great gaps in Higher Education in the country is found in continuing mathematics education. Due to this, and seeking to serve as a priority Mathematics teachers who work in Basic Education, especially in public schools, and who need improvement in their exercise and in their professional training, taking into account primarily the mastery of important mathematical objects for their teaching, the Coordination for the Improvement of Higher Education Personnel (CAPES), foundation linked to the Ministry of Education, which has among its responsibilities the expansion and consolidation of stricto sensu graduate courses in Brazil, together with groups or communities of study and

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scientific initiation in the area of Mathematics, under the coordination of the Brazilian Mathematical Society, a course proposal was prepared and sent, based on a successful experience of IMPA carried out in the Improvement Program for High School Mathematics Teachers (Papmem), with structuring at the national level in a network, generating the blended master's program in the area of Mathematics for the entire country, the Professional Master's Degree in Mathematics in National Network – PROFMAT.

Prepared by the Coordination for the Improvement of Higher Level Personnel (Capes), the proposal for the National Graduate Plan (PNPG) 2024/2028 shows a 25% drop in demand for vacancies in master's courses in 2020. Also in that same year, the Sucupira Platform recorded 21% of idleness in master's vacancies and an 11% reduction in the total number of people who enrolled in master's and doctoral programs. These are facts that are even more worrying because, in the same period, there was a 20% decrease in professional master's degrees.

Today PROFMAT is formed by a network of Higher Education Institutions, with the coordination of the Brazilian Mathematical Society (SBM), supported by the National Institute of Pure and Applied Mathematics (IMPA). It is one of several Professional Master's Programs aimed at the continuing education of Basic Education Teachers, and has guidelines established in the guidelines established by the Ministry of Education directed to the stricto sensu continuing education of teachers in practice, also providing support to higher education institutions and the network of members of the program.

According to the Profmat coordination, on its portal, the program aims to enable in-depth and relevant Mathematics training for teaching in Basic Education. At its creation, the Program was made up of 48 institutions and offered 1,192 vacancies in 54 campuses in all regions of the country. PROFMAT finds legal and referential bases in the National Education Plan – PNE, Law No. 13,005, of June 25, 2014, which has among its goals to train, at the graduate level, 50% (fifty percent) of Basic Education teachers, established by the PNE, and to guarantee all Basic Education professionals access to continuing education specifically in their area of expertise. Taking into account the needs, contextualizations, and demands in the country's educational scenario. The number of enrollments in stricto sensu graduate studies; valuing the teacher; and career plan.

According to the program's direction, since its creation in 2011, profmat has graduated 6,474 teachers working in classrooms in basic education. The course is offered throughout the country by a network of 106 associated institutions and currently has 2,670 students enrolled.

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In its curricular matrix, the program essentially includes in-depth disciplines of mathematical content, aiming to give the graduate a certified qualification for the exercise of the profession of Mathematics teacher.

Profmat Curriculum Matrix

1st Year	
1st Period	2nd Period
Numbers and Real Functions	Geometry
Discrete Mathematics	Arithmetic
2nd Year	
1st Period	2nd Period
Troubleshooting	Fundamentals of Calculation
Elective I	Analytic geometry
	Elective II
2nd Year	
Completion of the Master's Thesis	

Source: Authors

Electives: History of Mathematics Topics, Number Theory Topics, Introduction to Linear Algebra, Differential and Integral Calculus Topics, Mathematics and Current Affairs, Computational Resources in Mathematics Teaching, Mathematical Modeling, Polynomials and Algebraic Equations, Spatial Geometry, Mathematics Topics, Probability and Statistics, Educational Evaluation, Numerical Calculus, Mathematics and Current Affairs II, Course Completion Work.

There is a lack of concern or interest in offering didactic disciplines or an approach aimed at teacher training, even in elective disciplines. The Final Conclusion Paper of Profmat must deal with specific topics pertinent to the Mathematics curriculum of Basic Education, which produce an impact in the classroom.

Research focused on teaching theory and practice and the construction of meaningful learning for students and teachers should be provided by graduate programs such as PROFMAT, becoming a tool for professional development and engagement, providing emancipatory training for participants.

For Freire, the inseparability of theory and practice occurs through authentic praxis, actions that allow reflection on the individual's action, resulting in an emancipatory education. See:

> "Praxis, however, is the reflection and action of men on the world to transform it. Without it, it is impossible to overcome the oppressor-oppressed contradiction" (FREIRE, 1987, p. 38)

Reflecting on techniques and procedures that enable the understanding of the process of knowledge construction will always be of great importance in the search for approximation between the theory and practice of the mathematics teacher in the face of the constant and dynamic challenges that are presented to them in the educational space.

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In this way, training takes a "two-way" road; teachers who train teachers learn from the experiences and knowledge of teachers in the exercise of the educational space, and teachers in continuing education reflect their role as researchers by redirecting their practice.

Given this training profile, this research sought to show the state of the art of dissertation productions in the professional master's program in mathematics in national network that deal with teacher training, from 2012 onwards, considering the productions of the two areas of Capes: Education and Teaching.

THEORETICAL FRAMEWORK

We sought in Gatti (2001), Severino (2006), Gohn (2005), and Kilpatrick (1995) the theoretical framework to support the research by addressing the dropout, qualification, and training of teachers.

In 2001, Gatti already stated when writing an article on the implications and perspectives of educational research in contemporary Brazil, that little use is made of these researches produced by the institutions and pointed out that this was due to:

> [...] detachment of universities from practical problems; idealized and theoretical view of the university on teaching; lack of contact between government agencies and the university; theoretical character of the research; almost total lack of joint work; lack of dissemination of research results; difficulties for education administrators to make the transition from theory to practice; rigidity of the educational system in the absorption of innovative proposals; the little importance attributed to research in some government segments. (GATTI, 2001, p. 113)

We have in Severino (2006) a reference to graduate studies highlighting the statement that:

> [...] Graduate studies are one of the best segments of the Brazilian educational system under the criterion of the level of quality achieved and have contributed significantly to the construction of a more faithful portrait of the national reality, thanks to the systematization and institutionalization of the scientific practice of investigation, while at the same time training new generations of researchers. (SEVERINO, 2006, p. 52)

At this point, there is the construction of a positive scenario about the role played by graduate courses in the country, positioning itself as a promising path to the growth of teachers' qualifications.

Regarding the role of the teacher in graduate studies, Severino (1993) emphasizes that:

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> The professors of a Program cannot perform only as lecturers, they need to act primarily as research professors, or better yet, as teaching researchers.

To occupy this space in the graduate movement is to perceive in research a bridge for actions in schools and not to be reduced to the role of transmitter of information, as Gohn (2005) states:

> Only in this way can research be tools that promote qualitative changes, which contribute to the improvement of schools and the relationships that develop there (GOHN, 2005, p. 271).

However, we know that for the above statements to materialize, there needs to be an initiative by researchers and their institutions, in addition to government policies.

In particular, the work in the post-graduate field of Mathematics Education has changed to its object of research, giving greater emphasis to the process and not to the object, positively influencing the improvement of the qualification of the professional who teaches mathematics, as stated by Kilpatrick (1993) in his article:

> The world of mathematics teaching and learning was seen as a system of interacting variables. The objective of the research was to describe those variables, discover their Intercorrelations, and try to manipulate certain variables to achieve changes in others. Although some researchers in Mathematics Education still have this orientation, most have followed other researchers in education who have borrowed theoretical structures and techniques from the social sciences. Approaches seen as phenomenological, interpretive, social constructivist, or ethnographic have become especially popular among researchers in mathematics education. (Kilpatrick, 1993, p. 16).

It is clear the new direction for the courses of mathematics teacher training, giving greater importance to the training process, seeking phenomenological and ethnographic characteristics, enabling a holistic view of the process and the new space to be occupied by the professional who teaches mathematics.

Thus, it is really important to establish the current scenario of dissertations within the scope of the Professional Master's Degree in Mathematics in National Network – PROFMAT, which address the training of mathematics teachers, to serve as a consultation to groups of analysis, discussions and reflections on the impacts of the program on the training and professional practice of mathematics teachers.

METHODOLOGY

The research work is characterized in a qualitative approach depending on the objectives and focus of the investigation. This research has, among other characteristics, the intimate relationship between the researcher and the researched, a greater interest in

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the process, the description of the data focusing on the particular, seeking a greater level of depth of understanding of them, which are basic characteristics of a qualitative investigation (BOGDAN; BIKLEN, 1994).

The research was carried out to map the productions of desserts with an approach in teacher training in the Professional Master's program in Mathematics in National Network – PROFMAT in all institutions that are part of the program, and thus establishing the state of the art, and thus demonstrating the current scenario that portrays the moment of this research object in the country.

The state of the art consists of revealing elements in this field of knowledge, which allows us to recognize the proximities and singularities of a particular theme in a given period.

For Ferreira (2002), the State of the Art is a methodology that seeks to produce a balance of productions on a given theme in a period considered. It would not be just a literature review, but seek to point out a paradigmatic change in conceptions and methods associated with the theme, and indicates themes and perspectives that lack investment and deepening of investigation, identifying similarities and divergences from these theses and dissertations.

It is a bibliographic methodology, which has

> The challenge of mapping and discussing a certain academic production in different fields of knowledge, trying to answer which aspects and dimensions have been highlighted and privileged in different times and places, in what ways and under what conditions certain master's dissertations, doctoral theses, publications in journals and communications in conference and seminar proceedings have been produced. (FERREIRA, 2002, p. 257)

The initial work was done on the Portal of the Professional Master's Program in Mathematics in National Network – PROFMAT, where we found the history and characterization of the program, its legal bases, syllabuses, and regulations. Knowing its objective and what qualification it would be necessary to build in its masters, we followed the research of the dissertations on the CAPES Portal without much success because it did not have the national registry of the program's productions. After a recent update made on the PROFMAT portal itself, we found the entire database of completion works of the member institutions available for consultation. In this movement, having established the criteria for selecting the dissertations, we approached through the search for keywords that had mathematics teacher training and initial training.

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After the selection, the analysis of the dissertations that contemplated the objective of the work, dissertations that were characterized as initial training or that addressed the Training of Mathematics Teachers was carried out.

Surprisingly, due to the low number of studies that met the criteria established for this research, a comparative percentage analysis was made with the national studies of the program.

PRELIMINARY RESULTS

Initially, the table of Higher Education Institutions that are part of the National Profmat Network, called Associated Institutions, as well as the productions of dissertations produced until the end of 2021, is presented.

Table 1: Institutions that are part of PROFMAT/Dissertations in the country by regions.

Region	Institutions	Dissertations
Midwest	06	645
Northeast	22	2064
North	08	862
Southeast	52	1877
South	13	994
Brazil	101	6442

Source: Authors

We observed in the initial survey that the Southeast and Northeast regions, together, are responsible for 73.26% of the associated institutions and account for 61.17% of the dissertations, totaling 74 institutions and 3941 dissertations. It is also observed that the North, South, and Midwest regions represent 26.74% of the institutions and account for 38.83% of the dissertations produced, thus representing 27 of the associated Higher Education Institutions and 2501 master's completion works. The Northeast region stands out, which, compared to the number of associated institutions in the Southeast region (52), presents a representative number of dissertations (2064) about the country's production.

Considering the selection criteria of the research, Teacher Training and Continuing Education, the number of dissertations is considerably reduced. In addition to the low number of productions that address these two criteria, it is possible to perceive the construction of the theme around a specific mathematical object in most of the productions.

Table 2: Dissertations with an approach to Teacher Education and Continuing Education.

Region	Teacher Training	Continuing Education	Total
Midwest	01	02	03
Northeast	02	01	03
North	01	04	05

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Southeast	03	05	08
South	-	02	02
Brazil	07	14	21

Source: Authors

It is demonstrated that according to the selection criteria, Teacher Training and Continuing Education there is a minimum production, representing less than 0.3% of the total dissertations, only 21 works in the framework of 6442 in the country. Of the productions within the selection criteria, there is a greater concentration in the Southeast region (08) with about 38%, followed by the North region (05) with about 23% of the dissertations. If we take into account the number of Institutions Associated with Profmat, we have the production of the Midwest region with 03 productions out of 645, which represents 0.4% of the production, the Northeast region has 03 productions in 2064, representing 0.1%, the North region with 05 dissertations out of a total of 862, representing 0.5%, the southern region with 02 dissertations out of a total of 994, which represents 0.2% and the Southeast region with 08 productions in a total of 1877, representing 0.4% of the master's degree completion works.

From the analysis of the contents of the dissertations that initially met the criterion established for this work, teacher training and continuing education, an immersion in these works was made to verify if they contemplated the work as teacher training.

Analyzing the content means "a set of communication analysis techniques aimed at obtaining, through systematic and objective procedures for describing the content of the messages, indicators (quantitative or not) that allow inference of knowledge related to the conditions of production/reception (inferred variables) of these messages" (BARDIN, 1977, p. 42).

For this analysis, we followed the guidelines of BARDIN (1977, who recommends the adoption of three essential steps: a pre-analysis, through a floating reading to contact and organize the collected material. An exploration to deepen the perception of the material. And, finally, the treatment or interpretation, in which the analysis is more intense, to go beyond the content manifested in the material.

It is worth noting that characterizing a work as teacher training or continuing education implies considering the various experiences, histories, complexities, and contextualities of each one. These experiences imply consequences in the training process and characterize the teacher's view of what is defined as training. Thus, Gatti (2010, p. 117) states that:

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> [...] professional inserted in an educational context, which is at the same time national and local, which has socio-philosophical axes, but is made in the heterogeneity of the geographical-cultural conditions of this territory, which poses non-trivial problems that deserve investigative attention.

Based on this quote, we realize that the analysis of the dissertations under the aspect of the criteria adopted in this work focuses on a deepening of the characteristics of each of the selected dissertations, considering the aspects of each author's vision.

When analyzing the group of 21 papers, we eliminated 6 dissertations because we analyzed that they did not have teacher training or continuing education as the focus of the work, but rather addressed them as a complementary theme. Thus, 15 dissertations were grouped according to the following table.

Table 3: Number of dissertations found, according to categories of research objects on teacher education in the period 2012 to 2021

Categories of research objects on teacher education	Dissertations
Continuing Education	09
Initial training	02
Relationship Training and Pedagogical Practices	04
Total	15

Source: Authors

The classification of Continuing Education reached the highest percentage, 56.25%, of the dissertations on teacher training. The dissertations were:

a) Continuing education of mathematics teachers: an experience report with basic education teachers;
b) Problem solving: the need for continuing education of teachers who teach mathematics in elementary school i and ii.
c) The teaching of algebra in the early years: a proposal for a continuing education course in the light of the ideas of the bncc
d) Mathematics teaching and learning laboratory: potentiating tasks as research scenarios in the continuing education of teachers in the early years
e) A proposal for continuing education of teachers who teach mathematics in the early years of elementary school
f) Mathematical modeling in the continuing education of basic education teachers
g) Sets and functions: concepts, properties and demonstrations aiming at the continuing education of the mathematics teacher in basic education
h) The use of geogebra in mathematics teaching: a proposal for a mini-course in the

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continuing education of mathematics teachers

i) The profmat and the continuing education of the mathematics teacher of basic education

In the Initial Training classification, we found 02 dissertations out of a total of 15 works, which represents 13% on teacher training. These two dissertations refer, in their problematizations, to Teaching Degree courses. The dissertations analyzed in this subcategory are:

a) Inclusive mathematics: teacher training for the teaching of mathematics in hospital classes.
b) Conceptual gaps about numbers and their operations in the training of mathematics teachers.

In the classification Relationship Training and Pedagogical Practices, we found 04 dissertations, which represents 26.66% of the total production. In these works, problematic ones are related that question very specific practices of training, such as. The works are:

a) Training of teachers in the early years of elementary school: preparation for math olympiads;
b) Continuing education and the use of fractions aimed at the construction of knowledge;
c) A study on the theory of discrete probabilities: contribution to the continuing education of teachers Belém;
d) Dynamic geometry software in the continuing education of mathematics teachers: study of conics;

As a next step, we found it convenient, after the descriptive analysis of the dissertations, to establish an evolutionary analysis of the productions that met the chosen criteria, to serve as a comparison for future studies of the theme and compare them in similar analyses built in other works on teacher training at the master's level within Profmat.

Table 4: Evolutionary distribution of dissertations on teacher training produced in the Professional Master's program in Mathematics in the National Network – PROFMAT in the period from 2012 to 2021.

Categories of research objects on teacher education	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021

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Continuing Education		01				01	01	02	02	02
Initial training			01				01			
Relationship Training and Pedagogical Practices			02	01				01		

Source: Authors

Considering the history described in table 04, we noticed that in the Continuing Education category, the first production was made in the year following the beginning of the program, 2013. This is followed by a period of three years without a new approach until there is an intensification from 2017 onwards until 2021, characterizing a higher production from 2018 to 2021. Considering the Initial Training category, the table shows the low production and two isolated years, 2014 and 2018. In the category Relationship Training and Pedagogical Practices, in 2014 there will be the production of two dissertations and in 2015 another one. From then on, there is only a single production in 2019. Analyzing the evolutionary distribution, it is possible to notice a trend of intensification of the production of dissertations in the Continuing Education category in the last four years.

In the analysis of the evolutionary picture, it is noticed that in the interval from 2012 to 2021, the dissertations that developed their problems and approaches focused on the teacher, their experiences, the place they occupy, their workspaces and reflections of their actions in society began to have a voice and, little by little, become a source of research in the conclusion works of Profmat. These are signs of the need to provide opportunities and encourage new research that addresses these problems that will define the new posture of the professional who teaches mathematics.

SOME CONSIDERATIONS

We seek to establish in this work the current scenario of the dissertations of the Professional Master's Degree in Mathematics in National Network – PROFMAT, whose approach in its problematic was teacher training. The source of research was the portal of the PROFMAT program, where all dissertations from the period from 2012 to 2021 are available. We found a total of 6442 dissertations in the program distributed in 101 Associated Institutions

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in the five regions of the country. We established as a criterion for selecting the works that met the objectives of the research the classification in Teacher Education and Continuing Education, finding 21 dissertations. After a preliminary analysis, we eliminated 06 studies that, due to various elements, did not meet the objective of the research or related teacher training only in a tangential way. Of the remaining 15 dissertations, we analyzed them in more depth and classified them into three groups: Continuing Education (09 works), Initial Training (02), and Relationship Training and Pedagogical Practices (04). Another analysis carried out was the evolutionary distribution of dissertations to verify the productions by category in the period from 2012 to 2021 and to serve as a reference for future works on dissertations that address the training of teachers of the Professional Master's Degree in Mathematics in National Network – PROFMAT.

In this constructed scenario, we realize that although we have found a large number of productions that problematize specific themes pertinent to the Basic Education Mathematics curriculum, most of them have their development in a specific mathematical object. Unfortunately, dissertations focused on teacher training are minimal. Even though it has been found in several articles that research in Mathematics Education has become one of the main themes of investigation of mathematics education programs and with a tendency to expand, we realize that the structure of PROFMAT, whether in terms of the curricular matrix or the definition of the program's objectives, does not encourage the production of studies on the professional practice of those who teach mathematics, nor do they create seminars, congresses, meetings to discuss the current scenario of graduate programs to favor a greater opening of research possibilities on mathematics education, a reflection perceived in the few studies focused on this specific area in the three regions studied.

Thus, this work reveals the need to encourage new research that analyzes, reflects and discusses these themes, raising new possibilities, new interventions and new questions, providing a growth in the quality of graduate courses in mathematics and, consequently, a constant critical analysis of the performance of the mathematics teacher and its directions in mathematics education both in PROFMAT and in other programs aimed at teacher training.

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