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SYMBOLIC PRODUCTION IN GRADUATE PROGRAMS IN EDUCATION: CONTRIBUTIONS TO THE SCIENTIFIC FIELD OF MATHEMATICS EDUCATION IN MATO GROSSO DO SUL

A produção simbólica nos programas de pós-graduação em educação: contribuições para o campo científico da educação matemática no Mato Grosso Do Sul

La producción simbólica en los programas de posgrado en educación: contribuciones al campo científico de la educación matemática en Mato Grosso do Sul

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Abstract: The constitutive elements of a new scientific field, the factors that result in its conservation, and its relations with neighboring fields are themes that guide our investigations. Based on the studies of the French sociologist Pierre Bourdieu and historical sociology, we consider the intrinsic aspects of the existence of a scientific field: its symbolic production, the institutions, agents, and the scientific *habitus* — elements that directly contribute to both its creation and maintenance. Therefore, we focused on investigating the field of Mathematics Education in Brazil, more specifically in Mato Grosso do Sul (MS), developing a historiographical study that allowed us to understand the relationship between this field, the history of higher education in Brazil, and the creation of the national graduate system. The outlook presented here focuses on the results obtained in the investigation of symbolic productions of the theses and dissertations type, defended in *stricto sensu* academic postgraduate programs in Education in the state of MS between 1990 and 2020, obtained through a systematic review of digital databases, and their articulation with the creation and possible consolidation of the scientific field of Mathematics Education in the region. Therefore, we present the results obtained through these productions and the importance of contributions from neighboring fields, such as Education, for the creation of the field of Mathematics Education.

Keywords: sociology; Pierre Bourdieu; history of mathematics education.

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Resumo: Os elementos de constituição de um novo campo científico, os fatores que resultam na sua conservação e as relações com campos vizinhos, são temas que norteiam nossas investigações. Com base dos estudos do sociológico francês Pierre Bourdieu e da sociologia histórica, consideramos os aspectos intrínsecos à existência de um campo científico: a sua produção simbólica, as instituições, seus agentes e o *habitus* científico, elementos estes que contribuem diretamente tanto para a sua criação quanto manutenção. Neste sentido, nos debruçamos a investigar o campo da Educação Matemática no Brasil, mais especificamente na microrregião do Mato Grosso do Sul (MS), desenvolvendo um estudo historiográfico que nos permitiu compreender a relação entre este campo, a história do ensino de nível superior no Brasil e a criação do sistema nacional de pós-graduação. O recorte aqui apresentado dá enfoque aos resultados obtidos na investigação das produções simbólicas do tipo teses e dissertações, defendidas em programas de pós-graduação *stricto sensu* acadêmicos em Educação do estado de MS no período de 1990 a 2020, obtidos mediante uma revisão sistemática nas bases de dados digitais, e a sua articulação com a criação e possível consolidação do campo científico da Educação Matemática na microrregião. Por fim, apresentamos os resultados obtidos por meio destas produções e a importância nas contribuições de campos vizinhos, como o da Educação, para a criação do campo da Educação Matemática.

Palavras-chave: sociologia; Pierre Bourdieu; história da educação matemática.

Resumen: Los elementos constitutivos de un nuevo campo científico, los factores que redundan en su conservación y las relaciones con campos vecinos son temas que orientan nuestras investigaciones. A partir de los estudios del sociólogo francés Pierre Bourdieu y de la sociología histórica, consideramos los aspectos intrínsecos a la existencia de un campo científico, su producción simbólica, las instituciones, sus agentes y el *habitus* científico, elementos que contribuyen directamente tanto a su creación como a su desarrollo mantenimiento. En este sentido, nos centramos en investigar el campo de la Educación Matemática en Brasil, más específicamente en el Mato Grosso do Sul (MS), desarrollando un estudio historiográfico que nos permitió comprender la relación entre este campo, la historia de la educación superior en Brasil y la creación del sistema nacional de posgrado. El recorte que aquí se presenta se enfoca en los resultados obtenidos en la investigación de producciones simbólicas como tesis y disertaciones, defendidas en sentido estricto en programas académicos de posgrado en Educación en el estado de MS en el período de 1990 a 2020, obtenidos a través de una revisión sistemática en las bases de datos digitales, y su articulación con la creación y posible consolidación del campo científico de la Educación Matemática en la región. Finalmente, presentamos los resultados obtenidos a través de estas producciones y la importancia de los aportes de campos vecinos, como la Educación, para la creación del campo de la Educación Matemática.

Palavras clave: sociología; Pierre Bourdieu; historia de la educación matemática.

1 INTRODUCTION

The field of mathematics education in Brazil, as we know it today, is the product of a series of transformations that have occurred over time. Historiographical studies on the teaching and learning of mathematics engage with significant educational movements that have taken place from the imperial period to the present day. Beyond the major Brazilian educational reforms dating back to the first half of the 20th century, the following years brought significant changes in conceptions of teacher training. Specifically regarding the training of mathematics teachers, these changes directly impacted new eras for this science.

Beginning in the 1960s, with the increased demand for more qualified teachers, a movement to expand higher education began in the country, and, concomitantly, a new policy for implementing the postgraduate system was introduced. The goal of these programs was to provide better training for teacher educators. Furthermore, work was underway on the idea of a system capable of developing scientific research. Research in mathematics education demonstrated certain noteworthiness from the 1970s.

Along with the growth in the number of graduate programs and the implementation of policies to expand higher education, the second half of the 20th century was marked by the emergence of a new field, characterized as a professional and scientific discipline (Valente, 2020): the field of Mathematics Education[3]. It is in this context that we dedicate ourselves to investigating, based on historical evidence, the formation of this scientific field.

In this paper, we present partial results obtained through the doctoral research, still in progress, of the first author under the second author's supervision. The thesis proposal in question aims to analyze aspects of the field of Mathematics Education in the state of Mato Grosso do Sul (MS) based on *stricto sensu* academic productions that focused primarily on Mathematics Education, defended between 1990 and 2020.

The scope of this article is the investigative results related to the scientific field in question, which were obtained through the analysis of data on productions in Mathematics Education in programs in the "Education" area of the state of MS during the specified period.

This research is a historiographical study anchored in the theoretical and methodological assumptions of cultural history and concepts derived from historical sociology. Our main theoretical framework is the concepts developed by French sociologist Pierre Bourdieu (1983, 2001a, 2001b) regarding the scientific field. The concepts introduced here include those related to the notions of field and its constituents, such as agents, institutions, *habitus*, symbolic production, and scientific capital.

[3] Differentiation is given here between Mathematics Education with capital letters, referring to the area of knowledge, and mathematics education with lowercase letters, which is related to the mathematical knowledge that people teach or practice in their daily lives.

The choice of the aforementioned framework is justified by the argument that *stricto sensu* academic research, as a symbolic production, represents one of the constituent aspects of the scientific field. Subsequently, this production can be converted into a kind of capital of this field and will always be related to the agents that interact with it.

Therefore, we believe that analyzing symbolic productions in Mathematics Education created within *stricto sensu* graduate programs in Education in Mato Grosso do Sul will yield insights that help characterize the scientific field of Mathematics Education in the region, such field being one of the constituent aspects of the field as a whole.

Thus, we structured the presentation of our research into several stages, each of which focused on the following: the relations between the history of the national postgraduate system and the scientific field of Mathematics Education in Brazil; the scientific capital in postgraduate programs in Education and their contributions to the scientific field of Mathematics Education in MS.

2 THE RELATIONSHIP BETWEEN THE NATIONAL POSTGRADUATE SYSTEM AND THE SCIENTIFIC FIELD OF MATHEMATICAL EDUCATION IN BRAZIL

As one of the main elements in the composition of our research, the National Postgraduate System (SNPG), responsible for most of the scientific research developed in Brazil, establishes a direct relationship with the country's Higher Education Institutions (HEIs), but this articulation has not always been this way.

Graduate studies at higher education institutions were officially established in the 1960s, as a result of a series of influential events in the previous decades. Among them, we can mention: the movements in favor of the creation of universities for the development of research in Brazil – in the 1920s; the creation of formal doctoral programs (Magalhães, 2019), instituted with the "Francisco Campos Reform[4]" (1931); the publication of the Statute of Brazilian Universities (Brazil, 1931), which defined the university model to be adopted in Brazil (Rothen, 2012); the "Manifesto of the Pioneers of New Education" (1932), which recommended the creation of universities to integrate teaching and research activities; and the creation of the Faculty of Philosophy, Sciences, and Letters of USP in 1934, which presented a rapprochement between research practice and higher education institutions in the national territory (Martins, 2018).

Despite maintaining proximity between scientific research and higher education institutions, the Brazilian university system had no tradition in this area (Gatti, 2001). The main institutional objectives of Brazilian universities, with few exceptions, were not focused on research, but rather on teaching.

[4] Francisco Campos held the position of Minister of Education and Public Health at the time. The reform that bears his name officially established the modernization of Brazilian secondary education at the national level.

The regulation of postgraduate courses in the country was established in 1965. The Ministry of Education and Culture (MEC) requested, at the time, the Federal Council of Education (CFE) to define and regulate postgraduate courses[5]. Intended for the training of researchers and teachers for higher education courses, postgraduate studies would, in their essence, according to Nazareno and Herbetta (2019, p. 104), "qualify professionals focused on scientific production and who contribute to national development".

The creation of Opinion No. 977/65 (Brazil, 1965) brought several definitions to Brazilian postgraduate studies, such as the distinction between *Stricto Sensu* and *Lato Sensu* modalities. In addition to the aforementioned opinion, it is important to mention Law No. 5,540 of 1968 (University Reform Law), which had a significant influence on the origin, expansion, and consolidation of this system. This Law established conditions for the admission and promotion of professors in Universities (Schwartzman, 2022).

Not only do Laws and Opinions express importance in the conceptual definition and legal framework of postgraduate studies, the National Postgraduate Plans (PNPGs) are crucial elements in the construction and maintenance of the system, carrying out diagnoses, establishing goals and actions (Brazil, 2010a, 2010b). The first National Postgraduate Plan dates back to 1975 (Brazil, 1975) and the last was launched in 2011. Currently, work is underway on the VII PNPG (2021-2030).

According to the literature, it is believed that the policies that structured the Brazilian SNPG meant that, in 50 years, Brazil developed the largest postgraduate and research system in Latin America (Barreto; Domingues, 2012; Schwartzman, 2022), which is also reflected in a significant number of scientific publications highlighted on the international scene and made Brazil into an integral part of what would be a representation of the global scientific community.

The Georeferenced Information System (GEOCAPES) of the Coordination for the Improvement of Higher Education Personnel (CAPES)[6] provides data on the SNPG from 1998 onward. Although the most recent data accurately represent the scenario studied, data presented for the 1990s demonstrate inconsistency and instability. However, given this caveat, we can use this system as a data source, not strictly reflecting the realities of the time, but as a good approximation, given the difficulties in recording data at that time.

Considering the important point made in the previous paragraph, it is possible to verify the expansion of *stricto sensu* graduate programs in Brazil based on data from the GeoCapes system. According to the first available data, referring to 1998, between enrolled and graduated students, the SNPG had 92,350 students throughout Brazil, distributed across 1,259 graduate programs. In 2021, the year of the latest available data, as of the date of writing this article, the number of enrolled and graduated students grew to 405,174, distributed across 4,691 programs at Federal, State, and Private HEIs.

[5] Expressed in Art. 69 of the Law of Guidelines and Bases of Education (LDB) No. 4,024, 12/20/1961.
[6] Management body for postgraduate studies in Brazil.

Regarding the state of Mato Grosso do Sul, the region of Brazil chosen for our investigation, using the same parameters used previously, the data indicate that in 1998, the number of students enrolled and graduated in the region was 135, distributed across seven graduate programs at federal higher education institutions. In 2021, the number rose to 5,417, including students enrolled and graduated across 83 graduate programs at federal, state, and private higher education institutions. It is important to emphasize that the initial data for Mato Grosso do Sul are incomplete, as they do not include the graduate programs offered at private higher education institutions at the time. Making a comparison with our database, in which we investigated several MS postgraduate programs, we noticed the absence of data from the Postgraduate Program in Education at the Dom Bosco Catholic University, for example, a program highlighted in our research, with the master's course established in 1994. Despite its drawbacks, GeoCapes aids us in the search for our objective from a broad viewpoint.

Given the interest in understanding how research in Mathematics Education was established on a national level and, later, at a regional level, we find in the work of Fiorentini (1994) significant historical contributions:

> The emergence, in the 1970s, of several Postgraduate Programs in Education, Mathematics, and Psychology aimed, among other things, to also meet the demands for improved qualifications of those responsible for training mathematics teachers (Fiorentini, 1994, p. 174).

Before the creation of the field of Mathematics Education, publications on mathematics teaching were predominantly conducted within the field of Education. Through disputes and tensions within this field, a new field, with its own set of challenges, was created. However, the contributions of the field of Education must be recognized, as Valente points out:

> There is no autonomous, isolated scientific field that is self-sufficient. It is necessary to affirm, of course, the existence of neighborhoods [...]. But it is necessary to be clear about what distinguishes the new field from the others: its singularities in terms of its own research problems (Valente, 2020, p. 197).

In comparison to the field of Education, Mathematics Education is a relatively recent research field, but this recency does not diminish its legitimacy or potential, as Venturin (2015, p. 535) shows us:

> [...] even though it is a recent field of research at the university, it is strong in terms of research, and this is evidenced by the formation of researchers in the area and the highlights of scientific production on the international scene.

At the heart of the establishment of the scientific field of Mathematics Education during the 1980s are actions that directly relate to characteristic aspects of the scientific *habitus* and directly impact the struggles for the establishment, functioning, and preservation of the fields (Bourdieu, 2001b). In this sense, we can mention the creation of academic congresses in the area, specialized journals, the opening of new postgraduate programs, and the creation of the Brazilian Society of Mathematics Education (SBEM) in 1988.

In Mato Grosso do Sul, the region chosen for our research, the field of Mathematics Education has demonstrated representation since the 1980s, with the creation of the Mathematics Degree program at the Federal University of Mato Grosso do Sul (UFMS) in 1981, linked to the Department of Mathematics (DMT); the creation of a DMT-UFMS-UFMS-related journal, LEMA (Mathematics Teaching Laboratory Journal), in the same period; and the establishment of SBEM-MS in 1994 (Pais; Freitas; Bittar, 2008; Silva, 2015; Larrea, 2016; Leite, 2019). However, the creation of the first master's degree in Mathematics Education in the state occurred only in 2007, within the scope of the Graduate Program in Mathematics Education at UFMS.

Pioneering professors in the creation of the Postgraduate Program in Mathematics Education at UFMS (Bittar; Freitas; Pais, 2017) report that, before the creation of this program, they supervised research related to mathematics education in the Postgraduate Program in Education (PPGEDU), in the line of research in Science and Mathematics Teaching at the same institution.

The establishment of a scientific community in the field of Mathematics Education in MS resulted from a series of actions that would entail the creation of specific graduate programs in the field. These, in turn, are expanding due to the creation of new courses at different HEIs throughout MS.

3 CONSTITUENT ELEMENTS OF THE SCIENTIFIC FIELD OF MATHEMATICAL EDUCATION IN MS

The establishment of the field of Mathematics Education as a scientific field was discussed in the previous sections. In summary, its emergence parallels the history of the SNPG and, consequently, of graduate programs, which are primarily responsible for scientific research in the country.

The partial research results presented here, regarding the *stricto sensu* academic production in mathematics education in graduate programs in Education, are justified by the idea that identifying and analyzing information provided in these works contributes to a historical characterization of the scientific field of Mathematics Education in Mato Grosso do Sul. On a broader level, these findings will integrate a systematic account of the history of Mathematics Education in Mato Grosso do Sul as both a professional and scientific field.

To Bourdieu (1983, p. 89):

> A field — even the scientific field — defines itself by (among other things) defining specific stakes and interests, which are irreducible to the stakes and interests specific to other fields (you can't make a philosopher compete for the prizes that interest a geographer) and which are not perceived by someone who has not been shaped to enter that field (every category of interests implies indifference to other interests, other investments, which are therefore bound to be perceived as absurd, irrational, or sublime and disinterested). In order for a field to function, there have to be stakes and people prepared to play the game, endowed with the habitus that implies knowledge and recognition of the immanent laws of the field, the stakes, and so on.

Thus, we will consider in this work, based on Bourdieu's studies, that the scientific field is a sociology of the intellectual field or a sociology of the fields of production of symbolic goods, which, in turn, will be converted into a type of capital.

> [...] a particular kind of symbolic capital, capital based on knowledge and recognition. Power that functions as a form of credit presupposes the trust or belief of those who support it because they are willing (due to their training and the very fact of belonging to the field) to grant credit (Bourdieu, 2001b, p. 53).

In short, a thesis or dissertation is characterized as a symbolic production, assigned value upon its approval by a defense committee, thus becoming a form of scientific capital validated by the agents within that field. These agents, the members of the committees, are chosen arbitrarily and are given a kind of power, capable of legitimizing whether a given work will be known and recognized within that community. The prominent place attributed to these agents in the field's hierarchy was constructed through the accumulation of different types of capital, including scientific capital itself—capital specific to this field. "When one speaks of specific capital, this means to say that this capital is effective in relation to a particular field, and therefore within the limits of that field, and that it is only convertible into another kind of capital on certain conditions" (Bourdieu, 1983, p. 90).

Another important detail is that this type of capital is personal, non-transferable, and non-monetary. It will always be linked to the scientist (Bourdieu, 2001b), and its reward is assured by peer evaluation, resulting in positions, participation in societies, reputation, awards, etc.

The sociologist also highlights that "symbolic capital attracts symbolic capital: the scientific field gives credit to those who already have it. The most well-known are those who benefit most from symbolic gains" (Bourdieu, 2001b, p. 81). For this reason, a kind of "capital accumulation" which results in symbolic power, of the scientific kind already mentioned. It is important to emphasize that a scientific field, as a socially constructed

field of action, places relationships and disputes, as well as the accumulation of capital, as part of the *habitus* of that field (Bourdieu, 2001a).

Given the above, to investigate symbolic productions, we focused on postgraduate programs classified under the "Education" evaluation area by Capes (2020). Accordingly, we identified and selected relevant programs and then examined the theses and dissertations in Mathematics Education produced within their master's and doctoral courses.

A total of six programs were selected from four institutions: Dom Bosco Catholic University (UCDB), Federal University of Mato Grosso do Sul (UFMS), State University of Mato Grosso do Sul (UEMS), and Federal University of Grande Dourados (UFGD). For a better visualization, we have included information on the number of productions and their respective institutions in the table below:

Table 1 – Postgraduate Programs in Education

Institutions and Academic Programs	**Courses and Periods[7]**	**Total number of selected works**
Dom Bosco Catholic University – Postgraduate Program in Education (PPGE)	Master's degree (1994-2020)	20
	Doctoral degree (2010-2020)	02
Federal University of Mato Grosso do Sul – Postgraduate Program in Education (PPGEdu) Campo Grande Campus	Master's degree (1988-2020)	23
	Doctoral degree (2005-2020)	13
Federal University of Mato Grosso do Sul – Postgraduate Program in Education (PPGE) Pantanal Campus	Master's degree (2009-2020)	01
Federal University of Mato Grosso do Sul – Postgraduate Program in Education (PPGEdu) Três Lagoas Campus	Master's degree (2019-2020)	zero
Federal University of Grande Dourados – Postgraduate Program in Education (PPGEdu)	Master's degree (2008-2020)	01
	Doctoral degree (2014-2020)	zero
Mato Grosso do Sul State University – Postgraduate Program in Education (PPGEdu) Paranaíba Campus	Master's degree (2011-2020)	04

Source: Prepared by the author.

[7] The period spans from the year each program was established, serving as the lower limit, to 2020, which marks the upper limit defined in our overall timeframe for the study: 1990–2020.

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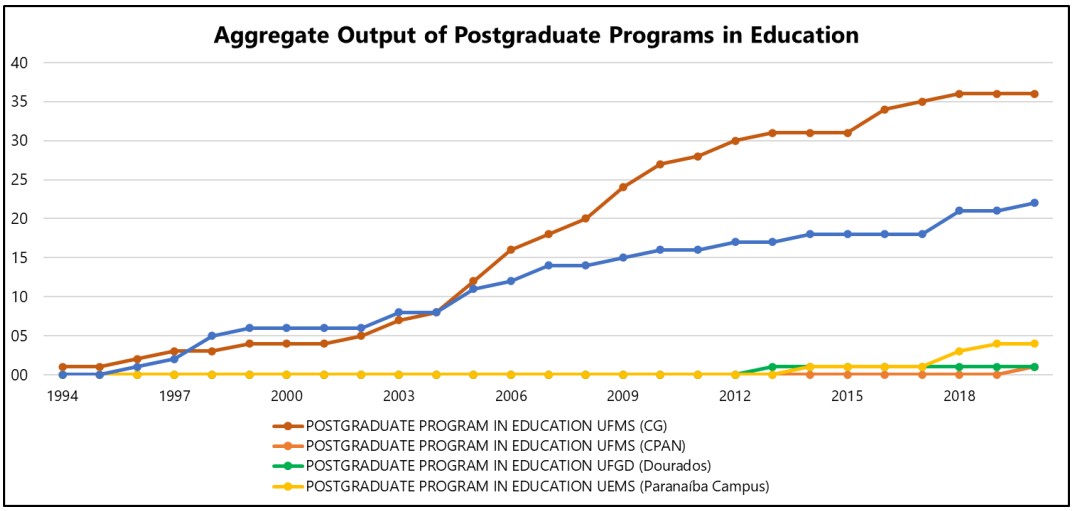
Information regarding elements that contributed to a characterization of the history of mathematics education production in the state was extracted from their abstracts, front and back covers. This information was organized through the cataloging process with the following data: institutions, agents, and type of symbolic production (thesis or dissertation).

Among the six graduate programs selected, five produced at least one study that met the established parameters for our research analysis. The analyzed papers had to present a study on mathematics education as their central theme, whether focused on the training of mathematics teachers, the teaching and learning of mathematics, or mathematics curricula. In total, abstracts from 1,487 papers were analyzed, and of these, 64 were selected, representing 4.30% of the total.

For a better visualization of the data, in the following figure, we present a graph with the accumulated total of the selected productions.

Figure 1 – Output of Postgraduate Programs in the Education field in MS



Source: Prepared by the author.

The Graduate Program in Education at UFMS (Campo Grande Campus) produced the most research projects in Mathematics Education (36), and is also the oldest program. Next in line is the Graduate Program in Education at UCDB, with a significant number of research projects (22). The remaining programs collectively account for six works, all of which are at the master's level.

Three categories of interconnected agents were also established: the authors of the research, their advisors, and, finally, the members of the committees. In total, the relationships between 162 agents were analyzed. Each agent, as an author, established relationships with three or four other agents as committee members.

In this context, the agents who stood out most were professors José Luiz Magalhães de Freitas, Marilena Bittar, Luiz Carlos Pais, and Leny Rodrigues Martins Teixeira. The first three supervised research projects at UFMS, and the last supervised research projects at UCDB. The data show that there was interaction between the four

agents, who were sometimes invited to participate in the committees and, at other times, were the research advisors.

There were cases in which no direct relationship was recorded between one agent and another, as in the case of Teixeira and Pais. However, they are part of the same community, given that their connectivity may be constructed indirectly, as both had direct and repeated interactions with Bittar and Freitas. Furthermore, we can infer that the recognition an agent receives for their capital accumulation from other members of this community is independent of the educational institution to which they belong.

Naturally, some defense committees included members who did not participate in any other committees examined in this study and, as such, have no direct connections with other agents. Nevertheless, they are still part of this community due to their shared objective.

4 FINAL CONSIDERATIONS

The various educational movements that took place during the 20th century made important contributions to the creation of scientific communities and, consequently, scientific fields. This process enabled us to understand the formation of a complex yet seemingly solid and expanding scenario across the country.

The creation of communities in favor of research, and more specifically, research in Mathematics Education, demonstrates efforts to grow this field. The connection between the field of Mathematics Education and the neighboring field of Education has proven not only present, but necessary. It was from research initially recorded in Graduate Programs in Education that the need for the creation of a new field with its own problems was recognized, as shown in the literature on the subject. Tensions are part of the creation and maintenance of fields.

When we began our investigation, we already had evidence from the existing literature on the topic that publications on mathematics teaching were dominated by the field of Education. However, we needed to characterize how this phenomenon unfolded in the state of Mato Grosso do Sul.

The identification of diverse research projects, together with a consolidated scientific community composed of prestigious mathematics education professionals, yields important results. The data leads us to conclude that this is a well-organized scientific community that would subsequently work toward the creation of its own mathematics education programs.

Thus, we can infer that the scientific field of Mathematics Education in MS was formed under the significant influence of postgraduate programs in Education. In the thesis still in development, data indicate that 26.9% of the total productions investigated (238) stem from research in this area. This represents a significant outcome when constructing a historical overview of productions within the scientific field of Mathematics Education in the region.

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Authors' contribution

Kamila da Fonseca Veiga Cavalheiro Leite - was the main author, responsible for the research, development, analysis, and writing of this article, which constitutes an excerpt from her doctoral thesis.

Edilene Simões Costa dos Santos - acted as an advisor, contributing with theoretical guidance, critical review, and correction of the text.

Declaration of conflict of interest

The authors declare that there is no conflict of interest with the article: "Symbolic Production in Postgraduate Programs in Education: Contributions to the Scientific Field of Mathematical Education in Mato Grosso Do Sul".

Data availability

The data underlying this research are contained within the article.

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