

## Brazilian research on philosophy of mathematics education: overview

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**Abstract:** *This paper provides an overview of the research presented over the past five years at national scientific events in discussion groups on Philosophy of Mathematics Education. From reading the papers presented in the annals of these events we conducted a categorization of the research according to paper question and theoretical framework. At the end, we highlight the existence of four major themes that run through all the research.*

**Keywords:** Philosophy of Mathematics Education, Brazilian research, Mathematics Education, Mathematics Education research in Brazil

### INTRODUCTION

The proposal here is to take a look at the region of inquiry that has been outlined as Philosophy of Mathematical Education (PME) within Mathematical Education in the last five years. Our time frame is justified in our objective in this study, considering that we do not seek to delimit an origin of this region, nor even establish a historicity of its development. Those points might be found in Ernest *et al.* (2016) in the section wrote by Maria Bicudo and Roger Miarka.

The question that drove our gaze was: *What does a Philosophy of Mathematical Education do?* And at this point it is appropriate to differentiate what we call PME on the bases of the preceding article. When we use the definite article “the” we refer to the region of inquiry, when we use the indefinite article “a” we refer to a particular way of making, constituting, articulating philosophies in Mathematics Education.

Using an expression by Miarka (2015) we affirm that the understanding about what is, and the multiplicity of this being, conforms through its use. It seems to us that we established in the PME the possible multiplicity in the existence of different ways of operating within it.

We chose as significant the events “Brazilian Meeting of Graduate Students in Mathematical Education” - EBRAPEM (acronym in Portuguese) and “International Seminar on Research in Mathematical Education” - SIPEM (acronym in Portuguese), because these national events have recognized relevance in Mathematical Education and for organizing their proceedings accordingly with Brazilian Society of Mathematics Education working groups. Another two events must be mentioned: “International Symposium on Research in Mathematical Education” - SIPEMAT (acronym in Portuguese) and “Mathematics Education National Meeting” - ENEM

(acronym in Portuguese). These two nationwide scientific events are not organized in work groups like the previous one.

In our analysis we reached four major themes that say about the questions asked by the PME. These questions address the following broad trends: In what contexts is mathematics produced and what mathematics is produced? How is mathematical knowledge produced (or how knowledge is produced in mathematics)? What do we do when we say we do PME? What teachers' education rise from the PME? However, because they come from different philosophical conceptions the questions are formulated in different ways. If we highlight this, it is to say that we are not reducing to a common denominator what has happened within the PME but pointing out trends that are focused in perspective ways.

In the sections below we present out data and the analysis process that enable us to reach the four questions presented above. We conclude by pointing out the relevance of the possible results that emerged from this panorama. We highlight the existence of a convergence in research topics and show that the survey region is working collaboratively.

### **Methodology**

Bicudo, Meneghetti, Clareto & Baier (2018) produced an overview of PME in Brazil. Based on the papers presented in the 6<sup>th</sup> SIPEM, the authors pointed out the following themes as major on the research on PEM in Brazil: “learning and teaching mathematics, mathematics education, informatics and distance education, the school reality where mathematics education takes place, and mathematics education carried out in the teaching environment of elementary and higher education” (Bicudo *et al.*, 2018).

To us, it is necessary to keep in mind the facts of the analysis produced by Bicudo *et al.* (2018) that took place in only one edition of an event. In our study we increase the data trying to cover all the scientific events in which has PEM under its scope.

Our question, *what does a Philosophy of Mathematical Education do?* drive us to look what happens in the research field. To answer the question, the trends more than traditions. So, we chose to look at the scientific events nationwide in the last five years. This period enables us to look at more than one edition of each events.

There are four outstanding events: “Brazilian Meeting of Graduate Students in Mathematical Education” (EBRAPEM), annual event for students of masters or doctoral programs. Students might present their research projects, partial outcomes or final results reached in the previous year. “International Seminar on Research in Mathematical Education” (SIPEM), event happening every three years, intended to gather together researchers of Mathematics Education. This one presents scientific papers about research projects or case studies. All the editions, until now, occurred in south/southeast or middle west of the country. “International Symposium on

Research in Mathematical Education” (SIPEMAT) as the last one, gathered together researchers on Mathematics Education. All the editions of this symposium took place in north or northeast sides of the country. “Mathematics Education National Meeting” (ENEM) every three years event for professional researchers and students of all levels interested in Mathematics Education. This is the largest scientific event in the field in Brazil.

Keeping in mind the size of a country like Brazil, the location, in which those events took place, is important. International and even national scientific events occur simultaneously or in faraway distance to be attend by all Mathematics Education community. In this scenario some ideas may not be in constant circulation among the scientific events even the fact there are nationwide events.

In this paper we do not analyze papers from SIPEMAT and ENEM because they are not organized in work groups. So, there are not group dedicated to discussion over Philosophy of Mathematics Education. However, we may find papers presented in this event under themes that may converge to discussion on the scope of the PEM. In the next paragraph we pointed out some of this works, but they are not included in our final analysis. We took this decision because despite the fact that we recognize them as works in PME, they do not claim this position to itself. The goal of our study is to understand the field of research, so this standing is important.

In the period we are looking two editions of SIPEMAT took place. The first one in 2015 was organized under 5 themes, included “Cultural, sociohistorical and philosophical aspects”. Under this theme 34 papers were presented and 4 of them captured our attention. The following edition took place in 2018 under 10 thematic lines, none of them mentioned PEM our philosophical aspects. 186 papers are presented and 5 captured our attention. The papers highlighted deal with ontological and epistemological aspects of teaching and learning Mathematics and professional development of Mathematics teachers.

In the case of the ENEM, also two editions took place in the last five years. The 12<sup>th</sup> edition occurred in 2016 under 25 themes, one of them called “Philosophical and sociological dimensions in Mathematics Education”. The annals of this edition are not following the themes lines, so we could not know how many papers were presented. The last edition of ENEM took place in 2019 with also 25 themes one of them called “Philosophical, sociological and political dimensions in Mathematics Education”. 41 papers were presented under this thematic line.

As we pointed out the authors who presented their work in SIPEMAT do not appear again in SIPEM. The opposite is also true. ENEM is the only scientific event where some authors are put together. This fact is important because it shows that there are some ideas, some discussion in the scope of PEM are not in circulation all over the country.

The others two events that organized itself following the work groups of Brazilian Society of Mathematics Education, are analyzed below.

### **About the works presented at SIPEM.**

The seventh SIPEM, took place at Foz do Iguaçu in 2018, eight papers were presented in work group 11, Philosophy of Mathematics Education. In the sixth, which took place in 2015 at Pirenópolis, twelve papers were presented. All these papers were studied by us in the following procedures.

Each paper was read with our question in mind “what does a Philosophy of Mathematical Education do?”. We highlighted quotes that enable us to understand the theoretical framework and questions addressed by the author. When all the papers of one edition of the event were done, we moved to the next edition following the same procedure. And then we moved to the other event, EBRAPEM, and one by one all the papers were read with the same procedure.

A second step was to create some categories to the papers hosted in each event. In this moment we did not separate in edition, only in SIPEM and EBRAPEN. The third step consisted of working with the categories, analyzing all of them and seeking for convergences. We reached 4 main categories described below.

Our analysis highlights that the number of authors quoted in SIPEM is considerably smaller when compared to the citations present in EBRAPEM, as we will see below. Among others, the names that appear the most are: Ales-Bello, Arendt, Bergson, Bicudo, Deleuze, Foucault, Gadamer, Heidegger, Husserl, Larrosa, Merleau-Ponty, Stein and Wittgenstein, in alphabetical order.

The group of authors is also not very broad, with most of them remaining in the two editions analyzed. If we look at the history of its formation, we see that this amplitude is even smaller. In their entirety the authors were formed, or were formed and are active, in the south and southeast regions of the country.

Concerning the theoretical aspects, two schools are highlighted: the phenomenological philosophy of inspiration in Husserl, as pointed by Bicudo and Miarka (2016), and the post-structuralist philosophies of inspiration in Deleuze and Wittgenstein. The exception is the work of Meneghetti & Oliveira (2015), who discusses teacher education without assuming any of the philosophical attitudes previously mentioned, focusing on a description of the students’ statements about their experiences in the internship. However, the authors claim to have been inspired by phenomenological procedures to produce the analysis.

### **About the works presented at EBRAPEM**

In the 23<sup>rd</sup> EBRAPEM, held in 2019 at São Paulo, 9 works were presented in the Philosophy of Mathematics Education work group. In 2018, 5 papers were presented in the working group. In this edition EBRAPEM took place at Belo Horizonte. In 2017, the 21<sup>st</sup> edition of EBRAPEM took place at Pelotas, 5 works were presented in this year. In 2016, EBRAPEM took place at Curitiba, also 5 papers were presented at work group 11, on the occasion of the

twentieth edition. In the nineteenth EBRAPEM, held in 2015 at Juiz de Fora, 6 works were presented.

**The five editions analyzed took place in the south and southeast Brazil.**

The works presented at EBRAPEM show a much wider range of references adopted, 30 authors are quoted in all. In addition to those already mentioned in relation to SIPEM's works, the following authors are cited: Albuquerque Jr., Bachelard, Benjamin, Bhabha, Bicudo, Bruner, Butler, Derrida, Duran, Freire, Gallo, Granger, Gutstein, Larrosa, Lins, Mignolo, Miguel, Pierce, Ponte, Quijano, Rancierè, Rolnik, Russell, Skovsmose, Spivak and Viveiro de Castro.

**It is possible to notice in the works presented at EBRAPEM the circulation of the productions that were published in the annals of SIPEM.**

The group of authors is a little broader compared to that of SIPEM, however, only two authors appeared more than once in the analyzed editions. This shows a less frequent participation of researchers who are still developing their graduate work. We expected to find a transit of researchers between the two events, in the sense that research that is concluded will also be presented at SIPEM. Considering the time frame this would be possible to observe if it occurred. In Brazil, master's degree should be completed in two years and doctoral degree in four years.

With regard to the Philosophical schools to which the works are associated, there is a difference. As in SIPEM, perspectives based on Phenomenology, Deleuse's philosophy and Wittgenstein's philosophy are present and are in the majority. However, in 2015 the work of Valle, in 2016 the work of Gusmão and Pablón, in 2017 the works of Fagundes, Franco, Soares and Brandão in 2018 the works of Oliveira and Viana, adopted different perspectives. Among these, the works of Oliveira, Viana, Soares and Franco assume a posture indicate by the authors as Decolonize. In this perspective, references to philosophers such as Walter Mingolo, Gayatri Spivak and Anibal Quijano are highlighted.

**Results and analysis**

Moving toward the question that guides this text, we dedicate ourselves to an analytical movement based on the descriptions we have presented above. We first made a note of the categories that raised during a process of reading the works, presenting them in relation to SIPEM and EBRAPEM. Then, we look for convergences among them and highlight the issues with which the PME has been concerned.

In this analysis of the publications of the two editions of SIPEM, we highlight 4 categories: Mathematics "in different contexts/different Mathematics"; "Constitution of mathematical knowledge"; "Think about the field" and "Philosophical Aspects in/of the teacher education". We underline the term "contexts" in the first category to emphasize that it is not just cultural contexts, but also temporal contexts; mathematics today: how technologies have participated in the production, and teaching, of mathematical knowledge.



In relation to the first category, the works we include in it understand that mathematics is diverse, so we emphasize “different mathematics” in its nomenclature. In this category are works that focus on Mathematics in contemporary times, that is, as the current material conditions, the use of technology, for example, influences the work with Mathematics. When talk about different Mathematics, these works highlight the multiplicity of meanings that mathematics can assume when the production of knowledge in relation to the context in which it is being produced is focused. In this aspect this category points to the works that we also include in the second category, “Constitution of Mathematical knowledge”.

In the second category two approaches are evident to us, one that chooses to look at the process in the direction of seeing where it points and the other to look at what can escape, differ (and here we are not use in terms of the philosophy of difference). For this second group, Mathematics is there, but other things are around and these things around allow different approaches or divergences. For the first group, we are in perspective, but directed towards. In this category are works that deal with the analysis of teaching and learning experiences.

In the third category we include works that think about the field. In general, they are those who carry out a survey of what has been produced, carrying out a panoramic analysis and pointing out possibilities.

In the fourth category are works that study the Mathematics teacher education. This group involves both work that proposes philosophy as a way of analyzing education, as well as works that proposes philosophy as education promoter.

When we turn to the works published in EBRAPEM, we highlight 6 categories: “the contexts of Mathematics Education”; “Methodology” (ways of doing research); “Mathematics seen from today”; “Mathematics and its teaching”; “The different Mathematics”; “Thinking about the field”.

In the first categories are works that are dedicated, or that have the intention of dedicating themselves, to look at the spaces in which Mathematics Education takes place. That is, they do not focus on the teaching and learning of Mathematics, nor even on ways to promote the teaching of Mathematics. These works are concerned with analyses, producing a cartography in most cases, social contexts, power relations and issues viewed as tangent to Mathematics Education. The works in this group is divided into two ways of dealing with the contexts they are looking at: the first, associated with the perspective of decolonization, proposes a membership reversal. These are works that assume a political position to decentralize Mathematics and social relations based on Euro-centered identities. The second way of dealing, associated with the perspective of the philosophy of difference, focuses on these contexts by proposing openings without assuming a commitment to deconstructing the membership.

When we say that these works do not assume a social struggle, we are putting the philosophy of difference in contrast to decolonization. The second one is directly related to the thoughts of fighting against colonizing patterns. The works that assume the philosophy of difference seek to act within existing ongoing actions, producing movements that may come to cause other ways of being, since it is not the intention of this perspective establish new normative ways of thinking (territorialization in Deleuze terms).

The second category, “Methodology”, covers works that propose to think about ways of doing research. They point out, from different grounds, possible ways to carry out a research, as well as they propose to base some approaches in different philosophical perspectives.

In the third category, “Mathematics seen from today”, are the works that propose to analyze the relationship between mathematical knowledge and the ways that the material conditions of today allow its production.

In the fourth category, “Mathematics and its teaching”, there are works that are dedicated to analyzing or proposing mathematics teaching experiences. There are also works dedicated to thinking the curriculum of elementary education from philosophical perspectives.

In the fifth category, “The different Mathematics”, there are works that focus Mathematics as science in a perspective way; how, from different perspectives, Mathematics can differ from the politically established (Mathematics standards).

In the sixth category, “Thinking about the area”, there are works that intend to take a look at Mathematics Education, producing, for example, state of the art research.

These 10 categories, thinking SIPEM and EBRAPEM together, are not disconnected. We can observe in a first movement that the categories “The contexts of Mathematical Education”, “Mathematics seen from today” and “The different Mathematics” highlighted in the analysis of the works presented at EBRAPEM have consonance with the category “Mathematics in different contexts/ different Mathematics” highlighted in the analysis of SIPEM publications. Just as the category “Mathematics and its teaching” highlighted in the works of EBRAPEM corroborates the works in the category “Constitution of mathematical knowledge” highlighted in the works of SIPEM. There is a common category for the work of both events, “Thinking about the area”. And yet, the category “Methodology” highlighted in the analysis of EBRAPEM publications corroborates the notes of the category “Philosophical Aspects in/of the teacher education”, highlighted in SIPEM publications, when we think about the aspects of philosophies pointing out how analyze teacher education practices.

In this way, we have 4 major themes that say about the questions asked by research in the field of Philosophy of Mathematics Education (PME). These questions address the following broad trends: In what contexts is mathematics produced and which mathematics is produced? How is mathematical knowledge produced (or how knowledge is produced in mathematics)? What do we

do when we say we do PME? Which teacher education rise from the PME? However, as they start from different philosophical conceptions, as we have highlighted in the descriptions that we made earlier, the questions are formulated in different ways. If we highlight this, it is to affirm that we are not reducing what has been happening in PME to a common denominator. We are pointing out trends that are focused in perspective ways.

## CONCLUSIONS

One may ask: why is so important to you know what are happen in the Philosophy of Mathematics Education, as a research field?

To answer that we need make a short presentation of our PhD theses. In Paulo (2020) we present the results of our doctoral research. In that study we investigated the constitution and development of the Model of Semantic Fields (MSF), a theoretical model proposed by Romulo Campos Lins, an important Mathematical educator and researcher from Brazil. One of our results show the possibility of this theoretical model hold philosophical discussions and research in the scope of the Philosophy of Mathematics Education.

To make sure of this hypothesis first we need get know what has been done in the PME. What are the questions and procedures currently in discussion in the research field? As soon as we know that we may address the same questions to a, or from a, standpoint based in the MSF and look if the discussions are hold or not.

This paper come out to react to this concern. It is result of the pursuit that questions addressed to the MSF and get some answer. With what was presented here we can point how the MSF may relate to PME.

At the moment, the study shows that the PME in Brazil are addressing questions about ontological, epistemological, axiological and pedagogical questions in accord with is pointed by Enerst and Bicudo. What is new in our study and has not been pointed by previous investigations is the fact of the research's questions are dealing with different objects by the fact of been addressed from different theoretical framework, i.e., when a researchers based on Wittgenstein approach ask by learning Mathematics he/she is not questioning the same thing that a researcher based on decolonize approach asking by learning Mathematics.

The fact of seems like the same object focused from different perspective is a kind of "optical illusion". What we trying to say is, for having been formulated in different theoretical framework even the research that address the same questions are talking, or thinking, about different things. This is an issue that Brazilian researchers in PEM must be concern with.

Pointing this out is possible because of the theoretical framework given by Model of Semantic Field. The way knowledge is understood in this theoretical model enables researchers to



talk about different knowledge under the same statement. Is one of our expectations present in the future, this perspective, and the consequences of taking it in a research, to the Mathematics Education community.

At the moment, we highlighted the main concerns with which the Philosophy of Mathematics Education are dealing in two national events in Brazil. Our results cover up the research developed major in south and southeast of the country. We are also able to point out the existence of an uncovered gap in previews analyses of the field. For us this gap is result of the existence of many events in the country the follows different ways of organizing itself. This multiplicity makes hard to get know all the edges of the research field and consequently what is and is not produced under the assignment of Philosophy of Mathematics Education.

The PEM in Brazil under the scope of the events that occurs in south and southeast sides of the country, is produced majority from perspectives grounded in Husserl, Deleuze and Wittgenstein. Other perspectives like decolonize come up in the latest scientific events but with a halting nature. There are a broader of ways of doing research on PEM hiding under uninvestigated events that take place in north and northeast sides of the country.

In the future two study are desired: first one exploring the edges of the PEM and covering the annals of scientific events that may or may not cited PEM as main concern. The second one presenting the Model of Semantic Fields and its notions as a theoretical model that support philosophical arguments.

### Data availability statement

The data supporting the results of this study will be made available by the corresponding author upon reasonable request.

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