

## We need to Decrystallize the Mathematic

### Translated from a portuguese paper: *É preciso descristalizar a matemática*

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#### RESUMO

Este texto versa sobre questões e movimentos de pesquisa que têm se colocado caros para mim e para o Grupo História da Educação Matemática em Pesquisa (HEMEP). Versamos nele sobre uma preocupação ética na pesquisa a partir do segundo Wittgenstein e sobre uma proposta de compreensão empática do mundo. Apresentamos alguns trabalhos que se esmeraram na tentativa desta prática e apresentamos como isso nos impulsiona para novas pesquisas. Por fim, advogamos pelo entendimento da matemática como práticas sociais humanas localmente situadas (jogos de linguagem), desta forma, particulares e, ao mesmo tempo, semelhantes a outras tantas – do campo da Matemática ou não.

**PALAVRAS-CHAVE:** jogos de linguagem, formas de vida, práticas sociais humanas de matemática.

#### ABSTRACT

This text deals with questions and research movements that have become important for me and the History of Mathematics Education in Research Group (HEMEP). We deal with it on an ethical concern in research from the second Wittgenstein and a proposal of an empathic understanding of the world according to our readings about Wittgenstein. We present some thesis that has been careful in the attempt of this practice and we present how this drives us to new researches and produces some research themes. Finally, we advocate for the understanding of mathematics as human practices locally situated (Language Games), in this way particular and at the same time similar to others - in the field of Mathematics or not.

**KEYWORDS:** language-games, forms of life, human social practices of mathematics.

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## Brief words

This text appears as an attempt to expose the reader to research questions that move me and, eventually, the research group in which I participate. To get to these questions, we will walk through some topics: a discussion on Wittgenstein's ethical positioning in his second phase, some research that seeks to exercise an empathic movement of analysis, and, finally, the current issues that face the mathematics as language-games.

## What is the ethics that drive our research?

***ETHIC** (...). In general, science of conduct. There are two fundamental conceptions of this science: 1- the one that considers it as a science of/zm towards which the conduct of men must be oriented and of the means to reach such an end, deducing both the end and the means of man's nature; 2- the one that considers it as the science of the mobile of human conduct and seeks to determine such mobile in order to direct or discipline that conduct. (TOBERGTE; CURTIS, 2013, p. 380, verb. Ethics)*

In 2016 we were able to share a subject, Angela<sup>2</sup> and I, in which we discussed issues of a philosophical nature-based especially on the writings of Ludwig Wittgenstein and Jacques Derrida, thinkers have taken by us with great appreciation. In this discipline, a fruitful partnership was established between two different Graduate Programs (Mathematics Education and Language Studies) since, in addition to the fact that we have two teachers, one from each program, we had students from both research fields sharing readings and discussions. In this direction, our meetings were based on broad themes, which were possible to discuss from reading the works of the two thinkers. We have already had the opportunity to write about this discipline in another article (GUIDA; PINTO, 2017).

For the discussion that arises here, one of the themes discussed there will be taken: ethics. During the planning of the activities that would be carried out in the course, the choice of this theme was made by my discipline partner, bringing a series of Derrida's writings that touched the subject more directly. On the other hand, we brought to the discussion the "Lecture on Ethics" by Wittgenstein (1929) and the thesis of Horacio Luján Martínez (2001), especially Chapter II: "Wittgenstein's ethical

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considerations in the context of Philosophical Investigations”, since from the second phase of Wittgenstein, there was little material to directly discuss this topic.

As for the first work, which is situated in an intermediate position between the author's first writings and the last ones (entitled according to Wittgenstein), we see how his positioning, already at this moment, moves away from the possibility of thinking about a “general” Ethics, or philosophy of ethics that embraced it as such. Portela (2016), on the Conference, says that in it Wittgenstein:

(...) it maintains that ethical judgments are judgments of absolute value, therefore, they are not reducible to science, nor can they be described by language. Ethics, in Wittgenstein's view, as part of the supernatural, cannot be the object of science or of language, which only describes objects from the natural world. The consequence is serious for modern moral philosophy, that is, it is not possible to find the fundamentals of morality, nor to describe it in any way. (PORTELA, 2016, p. 86, Translated By Us)

The 'supernatural' aspect of this theme for Wittgenstein also denounces his great approximation to a 'divine' aspect of certain things 'in the world' or beyond, as well as closing his first phase work “Whereof one cannot speak, thereof one must be silent.” (WITTGENSTEIN, 2010, p. 90)

In Portela's explanation, he shows us how Wittgenstein's first words at this Lecture, already point to understandings of his understanding of ethics at this point in his production. He asks the public for patience when developing the theme, warning that in the end, they will understand its purpose. Besides, it draws the public's attention by warning that this is not a conference on logic, which many could be expected because of the frisson caused by the *Tractatus Logico-Philosophicus* (WITTGENSTEIN, 2010) and the topic addressed, ethics, could be taken for a logical analysis:

First, communication on ethics in the form of scientific dissemination will give a false impression that we could understand something that we cannot. Second, that his request for patience is a requirement to see what he hopes to show, namely, that Ethics concerns something that is out of the world, that is, it is not a fact. Therefore, it cannot be described as we generally describe the facts of the world. (PORTELA, 2016, p. 91) (PORTELA, 2016, p. 91, translated by us)

In addition to the metaphysics present in this Lecture and highlighted by Portela, there is an interesting aspect of Wittgenstein's notion of ethics. He seems to want to show that there is no precise definition for Ethics and, to do that, he walks through some meanings of the word, hoping that the reader will outline notions about what it is about (PORTELA, 2016). By not establishing a 'precise' definition, it does not seem to us much to suggest that Wittgenstein took some steps towards his new

philosophy, defended in his posthumous work, *Philosophical Investigations* (WITTGENSTEIN, 1968). The difference between the position of the *Lecture* and the *Investigations* is to think about the impossibility of this precise definition because it is something 'beyond' us and our language, in the first case, or to think that language games are constituted like this, without essential features and definitions accurate, what is often necessary is precisely a “blurred image”, as advocated in *Philosophical Investigations*<sup>3</sup>.

Regarding its first phase, countless works dealt with ethics in these writings, especially due to the existence of a specific text on the theme and the metaphysical aspect of this first phase. Such a trend does not gain proportional reflexes concerning his mature work. This may be because he does not directly address the issue of ethics, ethical issues, or ethics as a branch of philosophy:

After the great stream of ethical interpretations of the *Tractatus*, a mandatory question remained: if ethics was so important to him, why did he say so little - almost nothing - about it? We believe that it is the observations on religion and culture that will help to outline a picture of what would be **Wittgensteinian ethical thinking** within the coordinates of his later work. (MARTINEZ, 2001, p. 82 in boldface)

We highlight in the quote above a change in positioning, it is not ethics and the way it is treated by Wittgenstein, but the identification, by the readers, of an “ethical thought”, a position that proposes conduct, a common good. The absence of questions and writings on ethics, makes readers relate their position to Schopenhauer's ethical fatalism, to conformism or even a reactionary thought (MARTINEZ, 2001, p. 84). However, Martinez, supported by other authors (such as Hilary Putnam), makes comments stating that there is indeed an **ethical concern** in Wittgenstein's mature work, a type of conduct proposal that can guide our practices and here is the point at which we will anchor in the next discussions.

For Martinez, Wittgenstein's **empathic understanding**<sup>4</sup> of the world is presented, for example, in excerpts such as “don't think, but look!” (WITTGENSTEIN,

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<sup>3</sup> This blurred or imprecise image is the tone that marks the *Philosophical Investigations*, among the defenses made in this sense, is the language taken no longer as a reference (as proposed by St. Augustine) the meaning of words is not an entity (material or cognitive) but is its use in certain language games. We will adopt this position here, we will not bring rigid definitions, but we will try to use words and expressions so that our reader captures our way of using these. “One might say that the concept 'game' is a concept with blurred edges.—“But is a blurred concept a concept at all?”—Is an indistinct photograph a picture of a person at all? Is it even always an advantage to replace an indistinct picture by a sharp one? Isn't the indistinct one often exactly what we need?” (WITTGENSTEIN, 1968, p. 34, §71)

<sup>4</sup> In the wake of Wittgenstein, we do not intend to bring definitions here, but to use the terms so that in use their meanings are established. However, due to the limitations and nature of the text, we say: when we use “empathy” we use it as an adjective to people or ways of dealing with the world that take

1968, p. 31). According to his interpretation, Wittgenstein's proposal for a description tells his reader to observe how things are - how they work -, perceive the multiplicity of ways of living (forms of life) (WITTGENSTEIN, 1968, §. 241), of articulating ideas and concepts, searching in the other, in its language games, its legitimacy, instead of seeking to submit it to our games and modes of legitimacy, which would reinforce a unique aspect of validation and truth (MARTINEZ, 2001, p. 85), we would say: perpetuating an image crystallized. We would add here, in a movement analogous to that of Martinez, that the reader also realized that explaining a game is not playing it (emphatic words by Wittgenstein), any attempt at explanation or translation is inserted in another game, different from the one observed. Describing a football game is part of the practice of talking and explaining things, playing it is part of the practice of running, kicking, etc. - bodily the distance is stark. Describing a basic education classroom is dealing with rules of speech or writing, of perceptions and analyzes, theoretical references perhaps, being in front of a room with several students, dealing with their anxieties and desires, demands from the school management is another game - we can't confuse them.

In this empathetic understanding, it is not for us to translate the actions of someone, another, into my game, with my sieves and grammars, but to try to understand them within their own game, their validation rules.

This apparent conformity, previously pointed out, and the emphatic “don't think, but look!” it causes many anguishes to those who intend to guide their research based on a Wittgensteinian discussion: if we should just “look” and don't even want to “think” about, how can we produce research, theses, and dissertations? As Miguel (2015) points out, there is an enormous temptation in the academy to “explain” the world through our ‘scientific’ works. Scientificity itself, incidentally, is severely criticized by Wittgenstein for his claim to truth above all others. The Austrian philosopher criticizes James George Frazer for his work *The Golden Bough* (MIGUEL, 2015), in which he defends an evolution of human thought, which was based on a mystical thought and evolves to scientific thought, clearly hierarchizing these two distinct games. Frazer would be comparing these two games, wanting to evaluate mysticism by scientific criteria and not respecting it according to his criteria. For Wittgenstein, it is not an evolution, but different language-games and different forms of life.

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each other with respect, possibility of learning, we use it as an adjective opposite to apathy, insensitivity, indifference, etc.



In *Philosophical Investigations*, Wittgenstein proposes a new way of looking at language, where this definite article used here loses its meaning, starting to look at its multiplicity (and not unity), that is, at languages or, in its terms, for language games - equally legitimate and infinitely multiple.

To anchor language games, Wittgenstein talks about forms of life, an expression that appears very little in his texts, but that seems to give mutual support to language games. Each form of life has its own language-games, Wittgenstein exalts this aspect when commenting that if a lion could speak, we would not understand him, as he would speak of things that are not in our way of life: "If a lion could talk, we could not understand him." (WITTGENSTEIN, 1968, p. 329).

Along with these statements, we have in your work the nod to the impossibility of translation as we usually do, as the possibility of **fully** translating something from one language to another, this "ideal" possibility is surrounded by the statement: "[...] And to imagine a language means to imagine a form of life." (WITTGENSTEIN, 1968, §. 19). As the author links the meaning of words and expressions to the use made of them and not to an ideal object, mental or concrete, only the context of use - to use effectively - can signal an understanding/understanding of this use.

Bringing these issues and impossibilities to the debate posed here, we return to the question entitled this topic: what is the ethics that drive our research?

The first aspect that we highlight from these scores is the perception of the other as being complete and coherent with their life contexts (with their language games and forms of life). By this, we mean that it is not for us to look at the other, looking for absences, errors, or imperfections in him, as many academic types of research usually do - albeit in a veiled way. Several researchers look to mathematics classrooms, teachers, or textbooks in search of errors and successes, of the possibility of finding weaknesses or contradictions that can be overcome by the researcher's theoretical framework. More than an "attention" or "care" with our interlocutor, this is an epistemological stance: in the belief that I do not know their language games and the ways of legitimizing them; in the impossibility of translating their actions (which occurred in those language games that I don't know) to my games - in this one, we might be able to point out some kind of incongruity or legitimate way of playing. More than talking about this posture, let's show some exercises in this direction.

### **(Empathic) Research Movements**

In the practical implications of this posture is the legitimacy of what the teacher does in his classroom, for example. During the master's degree (GARNICA; PINTO, 2010; PINTO, 2009) we observed<sup>5</sup> several classes by two math teachers from elementary and high school, something around two weeks from each teacher, which gave us approximately 40 hours of recordings. At the time, we chose to seek support from Lins (1999) for this mode of reading, which he called **Positive Reading**. Among some his texts and his students' papers (described in the bibliography of the dissertation), we can infer that positive reading starts from the assumption that people act consistently in the situations/activities in which they are inserted, that is, they do what they do because they believe that it is what should be done at that moment - even if later reflections may want to judge otherwise. Even though using cognitive<sup>6</sup> resources, this way of reading seems to be in line with the impossibility of full translation, always pointing to ONE reading, that is, a production of the one who reads from the enunciation residues that effectively reach him.

This facilitated our analytical movement when we realized that we were not analyzing Monica and Joaquim, but producing readings from the waste that came to us, that is, we were in contact with a language game in which we did not participate effectively - even if one year before I had worked as a teacher of basic education like them, but in different schools, grades and with other students - which we tried not to judge, in front of our game or front of one related to academic mathematics, but to highlight its rules, its grammars. One of the teachers had graduated in Degree and Bachelor at a renowned institution of higher education a year earlier and was studying for a master's degree in Mathematics Education that year and, still, she saw "academic" mathematics and its "rigor" soften in his words and gestures when explaining the content, as in a painting by Salvador Dalí. There, mathematics took on other shapes, other colors, another life: it was another language game, anchored in other forms of life, in which no researcher or textbook writer would effectively participate.

*Straight lines that went from here to there, that cut, terrain limits, parade fashions, always standing and never crooked*, all of these expressions were part of the language game practiced in those classrooms and from our point of view, without

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<sup>5</sup> This plural position I share with my advisor at the time, Antonio Vicente Marafioti Garnica, my co-supervisor, Heloisa Silva, and the GHOEM Research Group.

<sup>6</sup> Just to assist the reader in continuing reading, Lins proposes that the reader and author of a text are always produced cognitively from the biological authors and readers. When I read, I produce an author who says exactly what I understand (read) from that text. Likewise, when writing, the author imagines a possible reader and guides his writing by what this cognitive reader would understand / legitimize.

any mistake. or incongruity. It was up to us to try to understand the rules of those games, to try to understand why they did what they did. In addition to these actions, we also sought to produce a game in which we tried to make these perceptions explicit, which we call *A Mapping of uses of language in the Mathematics classroom*.

Throughout the master's degree - as part of GHOEM -, but more specifically in the doctorate, we dealt with issues of historiographical production in mathematical education and it challenged us to think about the epistemological status of these productions. Were these works rescuing the past, approaching facts that occurred from narratives, how did we face these issues? When working with oral narratives it is very common to have divergences from historical versions - but would it be possible to overcome the versions and obtain a story "in fact"? Again, in the face of language games, we were positioned: games and forms of life of yore no longer exist and cannot, in any way, be accessed, but we can produce new games that make us think about them, that dialogue with objects and documents left by the past and which are reframed daily.

Antonio Miguel (2012) in a lecture at the celebration of 10 years of GHOEM proposed to us think the past as a closed house, impossible to enter, but which we could spy from outside, see the shadows on the curtains, spy through the cracks. Packed by this and other metaphors (such as composite portraits by Francis Galton and Wittgenstein), we defend in our doctoral thesis the **production** of history, understanding that what we have in the present are exclusively the narratives about this inaccessible past, proposing an intentional confusion between history and historiography (PINTO, 2013, 2015).

This divergence of versions was made explicit in this work when we sought to produce stories about the Minerva Project, reports such as those of students in the interior of Rio de Janeiro, of a monitor in Coxim (MS), of a writer of the didactic material of Mathematics and the Producer of Project at the national level was very different. Given this, **how to deal with the difference?**

Some research movements would choose to erase them, highlighting what is common in all these reports. On the contrary, we chose to highlight and problematize them in a fictional radio debate. We were aware that this was a new game, that flirted with the language games of our interviewees, but aware of the impossibility of playing them effectively. In this way, it opened up the field of fiction, the creation of our characters, and the unprecedented possibility of putting them to talk and being able, thus, to explain these differences.



After completing a doctorate, I joined the post-graduate program in Mathematics Education at UFMS, with the first students and the search for new definitions of projects and meanings to research. If previously my work was adapted to a larger project of GHOEM and added to other works perceptions and notes that allowed a more comprehensive type of understanding on any topic, now it was time to think about which broader themes would comprise our project of research, so that each master's and doctoral work can be added to it.

Initially, in a very natural process, we outlined a project at HEMEP that aimed to investigate the training and performance of mathematics teachers in Mato Grosso do Sul (or south of Mato Grosso *uno* – before de division in two provinces) in other periods.

In this direction, works like that of Silva (2016) that investigated the formation of mathematics teachers in Paranaíba (MS) arose before the city had a specific course for such training. The research showed movements to search for courses in neighboring regions and the role that continuing education had in the city, especially for lay teachers and how political-party issues directly interfered in the classrooms of that city.

In the sequence, Ana Claudia (MORAIS, 2017) investigated the creation of the distance education Mathematics course at UFMS, showing the precursor projects of this initiative at the institution and the difficulties faced within UFMS itself for its institutionalization. At the same time, Renata Zandomenighi (2017) analyzed how training took place in the 1990s in a Mathematics course with an emphasis on Computer Science at a private institution in Campo Grande.

Corroborating these works, we have the creation of the Science course with Qualification in Mathematics at UEMS in Cassilândia (MS), investigated by Tatiana (GUEDES, 2018), which elaborates a narrative game in which this creation counts, the difficulties faced and the questions political parties that placed themselves above any other. Still on the history of the formation of mathematics teachers in Mato Grosso do Sul, we have the work of Vladimir, who looks at the first class of the Indigenous Intercultural Degree course "Folks of the Pantanal" (PROLIND) at UFMS, highlighting difficulties similar to those narrated by Ana Claudia in the institutionalization of the course, but with a serious aggravating factor: prejudice against the indigenous population in our state (BONDARCZUK, 2018).

All of these works also exercised the attempt to look at the other, not as oneself or as a stranger/exotic, but as someone who has their individualities, which is

coherent with their language games and form of life, which we can only timidly try to understand. In a sense, these characters who all appeared in this work were not analyzed, but their speeches, fixed in narratives, produced effects and movements on these researchers, which enabled the writing of new texts (belonging to other language-games, such as the academy).

In addition to these works, we have several others guided by other researchers from the HEMEP Group<sup>7</sup>, which we will not address here due to the size that the text would take.

We highlight, then, before addressing mathematics and its (de) crystallization more specifically, as announced in the title of the article, this ethical stance based on multiplicity, in a panoramic view of the world, strongly influenced by Wittgenstein.

### **The crystallization of mathematics: a unique way of thinking about it overlapping an evident diversity**

When looking at some math classrooms we can certainly see some similarities between them: some exercises and content in common, a teacher-centered mode of exposure, the use of images and notes, etc. Many, however, are the particularities kept in each community, society, and that are also manifested in the math class - no matter how much you preach your independence from the everyday world and the people who do it.

The similarities that have been described here could be found in classes from other subjects or even from other levels of education. A math class in the ninth grade of elementary school can have as many similarities as there are differences with a class of Differential and Integral Calculus of the undergraduate course in Mathematics or Engineering. These similarities certainly do not refer to identifying the same referent (in the background) for what is actually spoken in one space and another (a Platonic idea of number, function, for example).

Rejane Julio's (2007) master's thesis showed us how the word "dimension" is effectively used in various language-games, without the expectation of extracting from this uses an essence for the word, which would be its "original" meaning, its

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<sup>7</sup> The HEMEP Group was founded in 2011 and is led by Luzia Aparecida de Souza and Thiago Pedro Pinto; in addition, the following participate as researchers: Carla Regina Mariano da Silva, Kátia Guerchi Gonzales and Fernanda Malinosky Coelho da Rosa. Together with the respective advisors of each researcher. [www.hemep.org](http://www.hemep.org)

“essence”, on the contrary, strolling through the various possibilities of occurrence of this word proposes a panoramic view at it, a therapy of its uses.

Between the years of 2010, when I joined UFMS, until today, I worked several subjects for the distance education course in mathematics. Six effective teachers with some collaborators took turns in the disciplines to offer the course (which came to have 10 classes occurring simultaneously), among them I had the opportunity to work in two different moments with the discipline of Elements of Geometry (something like Euclidian’s Geometry in other courses). Between one offer and another, there was an exchange of books and, in the case of the axiomatic aspect of Geometry, it seemed that it would be just “a didactic question” that changed from one book to another. However, due to our fixation with the philosophy of language and the production of meanings (from Lins, 1999) we did not allow such acceptance and we were asked several questions and questions, which increased with the passing of the discipline. Could we have different axiomatics? Would the books achieve different results? Why was the numerical order of axioms/postulates and theorems different? Not content to silence these answers, Person Moreira set out to investigate them in his work, which had the theme *Language-Games and Flat Euclidean Geometry: a look at two didactic manuals for use in Mathematics Degree courses* (MOREIRA, 2018).

These first notes made by Person encouraged us to take this issue further, proposing a research project that would cover this issue and give scope to this problem<sup>8</sup>.

We understand that mathematics only exists as a social practice and its components are the actions and elements of these practices and not something outside them. By this, we mean that the social practice of school mathematics is done with bodies, desks, blackboard, chalk, and a series of statements and bodily performances, both by teachers and students. These characteristics, in fact, keeping their due proportions and particularities, are also present in mathematics classes in higher education. If there are similarities between mathematics practiced in the academy and in higher education institutions and that practiced in basic education, they may be much more related to the performances of its actors than to what we call mathematics (although these also exist).

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<sup>8</sup> Project entitled: Social practices, [M]athematics and School: between Decolonial Perspectives and Deconstructive Therapies - registered at UFMS.

In this attempt to empathize, we believe that the mathematics present in Basic Education is as legitimate as mathematics in higher education, in its space/form of life. This means that, in our research project, we will not try to legitimize each other, but rather look for similarities and dissimilarities in these two language-games, seeking to make explicit their grammars. As well as we can look for similarities and dissimilarities in the academic mathematics itself put into practice from different books or teachers, as Moreira (2018) did.

Mathematics as a social practice cannot be the same in very distant contexts since the practices (forms of life) are already different. We agree with Antonio Vicente M. Garnica regarding his epistemological positioning for mathematics:

Still regarding this issue, I suggest something that, at least in principle, could be a non-negotiable support point: the establishment of the concept that mathematics is not a set of objects that support different treatments, but a set of determined social practices. exactly for these treatments to the supposed “mathematical objects”. (MIGUEL et al., 2004, p. 92 – translated by us)

Thus, Euclidean Geometry as practiced by Euclid in his writing was extremely unique and irreproducible, although it has some small similarities with certain current practices. On the other hand, studying flat Euclidean Geometry with the help of books that modify Euclid's axiomatic, which put a teacher in front of the class to demonstrate theorems already demonstrated, make use of dynamic geometry software to show properties not only is far from Euclid's practice as it resembles several other daily classroom practices.

Crystallization, which entitles this text, may be related to ideas that are becoming common, speeches that are compacted and that are disseminated without further questioning, until they become hard and practically impenetrable (unquestionable in our case), such as, for example, “mathematics is only one, what changes is only didactics”, “mathematics at the university is more sophisticated than mathematics in basic education”, “flat Euclidean Geometry is a body of common knowledge”, among many others that we could enunciate here and that are easily heard in the academic and school context.

Our ethics, the defended conduct, is, precisely, to decrystallize these speeches, that is, to unpack them, to understand and to problematize how they are building, proposing a panoramic view for the theme: to go through the different uses

evidencing their similarities and differences<sup>9</sup>. “A *picture* held us captive. And we could not get outside it, for it lay in our language and language seemed to repeat it to us inexorably.” (WITTGENSTEIN, 1999, § 115, author's italics).

### Lastly...

We intend to put ourselves in research movements that seek to exercise empathy, that find the legitimacy of the other in **their** language-games and grammars. We also intend to look at mathematical practices without being restricted to specific locus but precisely pointing to specificities of these loci and similarities with others. With this, we intend to break with some barriers and crystallized discourses, which separate Mathematics from Mathematical Education. This does not mean ignoring the struggles and historical processes that mark such distinctions, but looking at these mathematical practices as human activities, which only occur precisely because of this human “interference”, without which they would not exist. In our view, rigidly separating these fields without the possibility of similarities would, in the extreme, be like proposing the existence of mathematics “without bodies” or of bodies “without mathematics”, in which interpersonal relationships or mathematics could constitute one without another, independent. Our focus is then on looking at mathematical practices in their environments of occurrence, inspired by Ludwig Wittgenstein's pragmatic view. Aiming to practice a therapy of these language-games, seeking to explain similarities, differences, grammars, and ways of playing practices that involve mathematics, in any fields that are present.

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<sup>9</sup> As an example, we add some questions that are in line with what we have proposed: How do terms like continuous and infinite have appeared in actual mathematical practices (language-games) in different disciplines or levels of education (current or other times)? As function, relationship and application are used at different levels of education, are there similarities, differences? What modes of use have been kept of Euclid's Elements for current books of flat Euclidean geometry?



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