

A normalizing mathematics (education): forum analysis of an extension course about gender studies and mathematics education

Una matemática (educativa) normalizadora: análisis de foros de un curso de extensión sobre estudios de género y educación matemática

Une (éducation) mathématique normalisatrice : analyse des forums d'un cours de formation sur les études de genre et l'éducation mathématique

Uma (educação) matemática normalizadora: análise de fóruns de um curso de extensão sobre estudos de gênero e educação matemática

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Abstract

The sociopolitical shift in Mathematics Education has allowed for the recognition of the non-neutrality of Mathematics, particularly concerning gender and sexuality issues. However, this movement is still not widely reflected in initial or ongoing teacher training for those who teach Mathematics, nor in pedagogical practices that have already been made public. Given this scenario, the aim of this text is to analyze the discussions in a forum from the extension course "Gender Studies: What does Mathematics have to do with it?" aimed at current and future teachers who teach Mathematics, regarding the possible stereotypes that Mathematics can (re)produce concerning individuals who diverge from gender and sexual norms. In this study, our intention is to provoke a sense of queering with the pseudoneutrality that has been discursively constructed as inherent to the discipline over the years. To achieve this, we have organized the analysis around three thematic axes: (i) the perception of Mathematics as a restricted or neutral field, (ii) gender dynamics in Mathematics, and (iii) pedagogical practices and materials as (non)potentiators of normalization processes. Based on our analysis, we conclude that Mathematics is still influenced by the intentions of a small portion of society that

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aims to maintain the status quo. We emphasize the necessity to challenge and break away from the (re)production of discriminatory processes that occur through Mathematics.

Keywords: Mathematics education, Gender and sexualities, Continuing education, Normalization process, Queering of mathematics.

Resumem

En este resumen, exploramos cómo el giro sociopolítico en la Educación Matemática ha permitido reconocer la falta de neutralidad de las Matemáticas, especialmente en lo que respecta a cuestiones de género y sexualidad. Sin embargo, este movimiento aún no se refleja ampliamente en la formación inicial o continua de docentes que enseñan Matemáticas, así como en prácticas pedagógicas que ya han sido publicadas. Dado este escenario, el objetivo de este texto es analizar las discusiones en un foro del curso de extensión "Estudios de Género: ¿qué tiene que ver la Matemática con esto?" dirigido a (futuros) docentes que enseñan (enseñarán) Matemáticas, sobre los posibles estereotipos que las Matemáticas pueden (re)producir en relación con personas que discrepan de las normas de género y sexuales. En este estudio, buscamos cuestionar la pseudo-neutralidad que ha sido construida discursivamente como inherente a la disciplina a lo largo de los años. Para ello, hemos organizado el análisis en torno a tres ejes temáticos: (i) la visión de las Matemáticas como un campo restringido o neutro, (ii) las dinámicas de género en las Matemáticas y (iii) las prácticas y materiales pedagógicos como potencializadores o no de procesos de normalización. A partir del análisis, concluimos que las Matemáticas aún están atravesadas por intenciones de una pequeña parte de la sociedad que busca mantener el statu quo, y señalamos la necesidad de tensionar y romper con la (re)producción de procesos discriminatorios que ocurren en y a través de las Matemáticas.

Palabras clave: Educación matemática, Géneros y sexualidades, Formación continua, Procesos de normalización, Cuestionamiento de las matemáticas.

Résumé

Le virage sociopolitique de l'Éducation Mathématique a permis de reconnaître la non-neutralité des mathématiques, en particulier en ce qui concerne les questions de genre et de sexualité. Cependant, ce mouvement n'est pas encore largement reflété dans les formations initiales ou continues des enseignants de mathématiques, ainsi que dans les pratiques pédagogiques qui ont déjà été rendues publiques. Face à cette situation, l'objectif de ce texte est d'analyser les discussions d'un forum du cours de formation "Études de Genre : Quel lien avec les mathématiques ?" destiné aux enseignants (futurs) de mathématiques, concernant les

stéréotypes potentiels que les mathématiques peuvent (re)produire en ce qui concerne les personnes qui s'écartent des normes de genre et de sexualité. Dans cette étude, nous visons à remettre en question la pseudo-neutralité qui a été discursivement construite comme inhérente à la discipline au fil des ans. Pour ce faire, nous avons organisé l'analyse autour de trois axes thématiques : (i) la vision des mathématiques en tant que domaine restreint ou neutre, (ii) les dynamiques de genre dans les mathématiques et (iii) les pratiques et les matériels pédagogiques en tant que facteurs (non) favorisant les processus de normalisation. À partir de notre analyse, nous concluons que les mathématiques sont toujours traversées par des intentions d'une petite partie de la société visant à maintenir le statu quo. Nous soulignons la nécessité de remettre en question et de rompre avec la (re)production de processus discriminatoires qui se produisent à travers les mathématiques.

Mots-clés : Éducation mathématique, Genre et sexualités, Formation continue, Processus de normalisation, Remise en question des mathématiques.

Resumo

A virada sociopolítica da Educação Matemática tem possibilitado reconhecer a não neutralidade da Matemática, principalmente no que tange às questões de gênero e sexualidade. Todavia, esse movimento ainda não é muito refletido em formações iniciais ou continuadas de docentes que ensinam Matemática, assim como em práticas pedagógicas que já tenham sido publicizadas. Em função desse cenário, o objetivo desse texto é analisar as discussões de um fórum do curso de extensão “Estudos de Gênero: o que a Matemática tem a ver com isso?” voltado para (futuras) docentes que ensinam (ensinarão) Matemática, sobre os possíveis estereótipos que a Matemática pode (re)produzir no que diz respeito às pessoas que dissidem das normas de gênero e sexuais. Neste estudo visamos o estranhamento da pseudoneutralidade que foi discursivamente construída como inerente à disciplina ao longo dos anos. Para isso, organizamos a análise em torno de três eixos temáticos: a (i) visão da Matemática como campo restrito ou neutro, as (ii) dinâmicas de gênero na Matemática e as (iii) práticas e materiais pedagógicos como (não) potencializadores de processos de normalização. Concluímos, a partir da análise, que a Matemática ainda é atravessada por intencionalidades de uma pequena parcela da sociedade que visa a manutenção do *status quo*, e apontamos a necessidade de tensionarmos e rompermos com a (re)produção de processos discriminatórios que ocorrem na/pela Matemática.

Palavras-chave: Educação matemática, Gêneros e sexualidades, Formação continuada, Processos de normalização, Estranhamento da matemática.

A normalizing mathematics (education): forum analysis of an extension course about gender studies and mathematics education

In the field of Mathematics Education, we have been experiencing a socio-political shift (Gutiérrez, 2013) since the last decade. In this shift, research in the field has incorporated new perspectives from social science theories that make it possible to envision the processes of teaching and learning mathematics being influenced by sociocultural and political factors. In other words, they make it possible to recognize the non-neutrality of these processes, something that some mathematics educators³ are still resistant to accepting.

In this context, in agreement with Reis & Esquinalha (2022), the socio-political turn "invites us to (re)think the presence of historically marginalized groups, such as blacks, women and LGBTI+ people, for example, within educational spaces and projects" (p. 63). Some of these groups have only been approached with more attention in recent years, especially LGBTI+ people, as evidenced in an article by Guse and Esquinalha (2022a). However, this debate still doesn't seem to be reaching the initial or ongoing training of teachers who teach mathematics, and we haven't identified many reports or research that discuss the presence of these discussions in mathematics classes.

We live in a constant need to revisit the ethical, political and/or aesthetic meanings that permeate the training and practices of teachers who teach mathematics, since, socially, discourses of pseudo-neutrality still prevail, which current research has sought to break down. We need to **queer** mathematics (Guse, 2022a), in order to reflect on how this discipline can contribute to the reiteration of processes of social normalization and seek ways to break with this (re)production that inferiorizes and silences bodies that dissent from these norms.

In this way, we have chosen to analyze the discussions in a forum about the possible stereotypes that Mathematics can (re)produce with regard to people who dissent from gender and sexual norms, with a view to breaking away from the pseudoneutrality that has been discursively constructed over the years as inherent to knowledge in general and, specifically, to Mathematics. This forum is part of an extension course called "Gender Studies: what does

³ Throughout this work, we use binary language to refer to people whose gender identity we know, and non-binary language - the "elu system" (Valente, 2020) - when the person is not explained according to their gender, marking a political position to make historically invisible people visible and also to replace the generic masculine. For those who want to know more about the system, we recommend reading "The 'x' and the '@' are not the solution: Elu System and Gender Neutral Language" (Valente, 2020). Available at: www.is.gd/sistemaelu.

Mathematics have to do with it?" aimed at (future) teachers who teach (will teach) Mathematics from all over Brazil.

In the second section, we will present some of the theoretical assumptions of this production, stressing the idea of normality and the binaries that structure mathematics, as well as highlighting the need to move towards **queering** mathematics (Rands, 2009). In the third section, we will present a general outline of the extension course to which this article refers, as well as our methodological assumptions, organizing the steps in an exposition without necessarily grouping the procedures and analyses into pre-existing methodological currents (Fiorentini et al., 2023).

In the fourth section, we will analyze one of the forums that made up the structure of the extension course. In this analysis, we will address three main axes: the (i) view of mathematics as a restricted or neutral field, the (ii) gender dynamics in mathematics and the (iii) pedagogical practices and materials as (non-)enhancers of normalization processes. Each axis will be discussed in a different subsection for a better understanding of the discussion.

To conclude, we will return to some of the reflections that have run through the production, highlighting how Mathematics is permeated by the intentions of a small part of society that aims to maintain the status quo, and pointing out the need for us to stress and break with the (re)production of discriminatory processes that occur in/through Mathematics.

Assumptions of a queer Mathematics: an escape from what is said to be normal

The concept of normality is socially and historically constituted. What is considered normal in our society is not, or has not always been, normal in others; what was considered abnormal at other times in the past is not abnormal today, and vice versa. What is considered normal in a given region in Brazil, for example, is not normal in others. It seems difficult to define theoretically what the terms normal and pathological mean. However, at the same time as we find it so difficult to define what "normal" is conceptually, it seems easy to attribute the word "normal" to a set of standards ideologically portrayed in a given culture, as if this same standard were immutable and unquestionable, or had an irretrievable practical meaning for us. (Maia, 2009, p. 266)

In Brazilian society, as in many other social contexts, there are power regimes that establish categories of normalization over people's bodies. These categories constitute classification systems and are used as a means of regulating and maintaining individual and collective life. As a consequence, they hierarchize bodies according to their (non-)belonging (or suitability) to these categories which, in turn, are directly associated with various axes of social differentiation such as race, gender, sexuality, religion, class, etc.

From a sociological point of view, society maintains its coherence under the aegis of **classificatory systems**, providing means by which we can make sense of the social world and construct meanings. For Kathryn Woodward (2014, p. 40), "a classificatory system applies a principle of difference to a population in such a way as to be able to divide it (and all its characteristics) into at least two opposing groups - us/them [...]; me/other". These are, therefore, shared and consensual forms of symbolic classification of people (and things) whose purpose is to maintain social order.

The main way in which classificatory systems are structured is around binary oppositions, i.e. two polarized and, by definition, opposing and mutually exclusive classes. However, alluding to the French philosopher Jacques Derrida, Tomas Tadeu da Silva (2014, p. 83) explains that "binary oppositions do not express a simple division of the world into two symmetrical classes: in a binary opposition, one of the terms is always privileged, receiving a positive value, while the other receives a negative charge".

In this sense, we can see that the way in which we classify the things around us is not unrelated to broader power relations; they establish hierarchies and are never exempt. In a patriarchal society, men - and, by extension, everything socially classified as "masculine" - are considered superior to women, as well as to attributes considered "feminine". The fallacy of white supremacy, in turn, grants white people privileges over those excluded from this category. In the same way, homosexual subjects have historically been pathologized, criminalized and constituted as "abnormal", giving heterosexuality the status of "normal" sexuality (Foucault, 2020). Our culture is therefore made up of such shared systems of signification that assign value to bodies in an asymmetrical way, depending on the positions they occupy within them. In addition, they are dichotomously organized around oppositions such as male-female, white-black, heterosexual-homosexual, cisgender-transgender, etc.

The problem is exacerbated when these forms of signification are mobilized as a basis for assigning meaning to territories that are not necessarily associated with either of the poles of the binary pair. As Londa Schienbinger (2001) warns us, the so-called "hard sciences" - such as mathematics, physics and chemistry - have historically been dominated by men, and women have faced various barriers and suffered various forms of violence, which continue to this day, in order to be able to work in these fields of knowledge. This is one of the factors that have contributed to these areas being socially and culturally perceived as "masculine" and, consequently, considered inappropriate, inaccessible and unsuitable for girls and women.

The very way in which these sciences are usually classified - "hard" - is a counterpoint to those considered "soft", which are supposedly appropriate for women. And these binary oppositions don't stop there: the former, as well as being hard, would be exact, endowed with certainty, neutrality, objectivity and based on rigid research methods with quantitative tools. The latter, on the other hand, would be inexact (or human), uncertain, politically biased and non-objective, as they are based on qualitative methods (Schienbinger, 2001). In this sense, the binaries that structure society also affect these sciences and categorize ideas that define which people can do them, as well as how to learn and teach them.

These oppositions - certainty-uncertainty, neutrality-politics etc. -, as well as the hierarchization that constitutes them, mean that the first terms are socially understood as superior to the second, even indicating primordial characteristics that any "hard" sciences should aim for (Detoni et al., 2022), in particular Mathematics, which will be the focus of this research.

Mathematics was for many years understood as a decontextualized, depersonalized science (Godoy, 2002), to which were attributed only characteristics of the "hard" sciences that legitimized which bodies could do such science. After all, in a social world that classifies bodies as "men" or "women", it is not difficult to deduce which subjects would be "suitable" to work in this field.

In addition to the discipline itself being organized by binaries and the fact that it is always sought to fit into a single pole in order to maintain its status of supposed superiority over other fields (Gutierrez, 2013), its teaching and learning processes are also crossed by a logic that can perpetuate normalizing ways of thinking which, in turn, legitimize social hierarchies, such as those of gender, sexuality, among others.

When we analyze the school environment, especially the dynamics surrounding the teaching and learning of mathematics (or physics, for example), we often see the citation, establishment and perpetuation of various social hierarchies. Instituted in (and by) language, the attributes we associate with boys and girls also follow the dichotomous and polarized logic described above (Louro, 2014): boys who show ability in the subject are considered brilliant, **naturally** skilled and with great potential; girls, on the other hand, when successful, are classified as hard-working, and their success is attributed to the fact that they follow rules and

behave "well". Thus, we could suggest that the way boys and girls are classified in/by the school in these subjects is organized around the binary pair **natural gift-hard work** (Detoni, 2023).

These stereotypes lead us to naturalize the different performances of students in mathematics and to consider it "normal" that boys often choose careers in the so-called exact sciences. In contrast, girls are constantly discouraged from pursuing such careers and suffer various forms of discrimination if they choose to do so.

Considering this scenario, it is extremely important that we think of ways to break with the hierarchization of bodies that happens in mathematics and other "hard" sciences, questioning a historical constitution that is articulated to the interests of a small portion of society. For this reason, as the researcher Kai Rands (2009) points out, we believe that we need to move towards a **queering** of (and through) Mathematics, a process that should be understood as a way of deconstructing and reconstructing the way in which this science was produced, as well as the means of learning and teaching it.

A movement of "queering" mathematics can be thought of as a movement that implies the (de)construction of the processes of knowing, learning and teaching. We need to use mathematics to ask questions about society, but also to use society to question and investigate the structures and habits that permeate mathematics (Detoni et al., 2022, p. 183).

The queering of mathematics can enable us to destabilize the binaries that structure it, as well as those that organize our society. In this sense, many people who are historically marginalized by this science can see themselves represented and occupy spaces that historically were not conceived for their bodies. In other words, we must make mathematics one more way of combating the means of normalization that, at all times, seek to erase and silence historically marginalized voices. In this way, we will be able to envision mathematics that re-signifies "what we have historically learned to be in order to envision what we can become". (Guse, 2022a, p. 132)

Understanding the research path: a look at online forums

The extension course "Gender Studies: what does mathematics have to do with it?" was promoted by the MatematiQueer research group, based at the Federal University of Rio de Janeiro (UFRJ), in partnership with the Federal Institute of Espírito Santo (IFES), the Federal Institute of Rio de Janeiro (IFRJ), the Federal Institute of São Paulo (IFSP), the Federal University of Maranhão (UFMA) and the Federal University of Pampa (UNIPAMPA).

The course was aimed at (future) teachers who teach (will teach) mathematics from all over Brazil, since it took place remotely. It was organized over eight weeks in which the following discussion topics were covered: (1) Genders and Sexualities in School; (2) Gender Studies and Mathematics Education; (3) Social markers of exclusion in Mathematics classes - the importance of intersectionality; (4) Feminisms and Mathematics Education; (5) Transvestitism and Transsexuality in School; (6) Queer Pedagogy and Mathematics Education; (7 and 8) Anti-male, anti-older and anti-LGBTI+phobic Pedagogical Practices.

The course started with 219 students and ended with 45. Because of the reduction in this number and considering that the first two weeks may have been the first contact many had with the field of Gender Studies articulated with Mathematics Education, in this production we will focus on the discussions of week 2. The activities relating to this week, as well as the others, were developed both asynchronously, through discussions in forums on the Modular Object-Oriented Dynamic Learning Environment (Moodle) platform, and synchronously, through debates in live presentations that took place on the YouTube platform. Both environments provided many discussions, but due to space limitations, we will focus on those that took place asynchronously in the Moodle environment, through the forums.

All the forums were preceded by a text prepared by the course organizers. These texts were intended to be objective so that the students could have an initial overview of the subject. The text for week 2 aimed to: (i) present research on Gender Studies and Mathematics Education produced in Brazil and (ii) provide reflections on how the themes of gender and sexuality permeate the daily lives of mathematics teachers. To this end, the historical construction of the field of Gender Studies was briefly presented, articulating its expansion on the Brazilian scene with the feminist movements of the 1960s and 1970s up to the way we understand it today. After this, some research was presented in the fields of Gender Studies and Mathematics Education that would enable a non-standardizing Mathematics (Education), that is, one that does not (re)produce social norms that inferiorize and silence those who are historically marginalized by society (and by Mathematics).

After reading this text, the course participants had to answer the following questions in the platform forum: **Do your conceptions of gender influence your work as a teacher or future teacher? And how can the research presented in week 2's text contribute to your work? Comment on the posts of at least two other people.**

This activity received 248 participations, including answers to the questions posed and comments on other participants' answers. Therefore, due to this large number, we read all the discussions in full and sent them to an electronic spreadsheet in order to organize them for later analysis. In this spreadsheet, we created some thematic categories to group together comments that had similar themes. The categories were: **Training, Teaching Materials, Scenarios of Prejudice, Representation of Teachers, Stereotypes of/by Mathematics and Family Resistance.**

For the purpose of this article, we will focus on the categories **Stereotypes of/by Mathematics and Teaching Materials**, since, although they are different, they complement each other and allow us to stress/reflect on the comments from a perspective that queers mathematics (Detoni et al., 2022). In addition, the limitations of the size of the production would make it impossible for us to go into the other categories and weave the theoretical links necessary for an in-depth analysis.

To make things easier to understand, we will use the codes E1, E2, E3, ... to identify the course participants' comments in the category **Stereotypes of/by Mathematics**, considering their respective number in the spreadsheet organizing the discussions, as well as MD1, MD2, MD3 for the comments in the category **Teaching Materials**.

Normal is different: analysis of the forums

I used to play a joke with my class when introducing the subject of function. I would divide the class into boys and girls and say that the dominant set was the boys' and the dependent set was the girls'. And I went further: I said that boys could have relationships with any girl they wanted or as many as they wanted, but for girls this rule wouldn't apply because they could only have one partner. Of course, the girls complained and there was a bit of discomfort with the LGBT+ students, because the boys made fun of the gays and lesbians in the class, who tried to keep a low profile. (E3)

The above account is one of the comments in the forum for week 2 of the extension course. We chose to start this section with this comment because we saw in it various topics that emerged during the debates that week, which will be discussed in separate subsections.

In general, we can see how mathematics is permeated by social issues, breaking away from a **view of mathematics as a restricted or neutral field**, which was the topic of the first subsection. Furthermore, there is a **perpetuation of gender dynamics in mathematics**, through the reproduction of gender roles associated with men's or women's bodies.

Society imposes arbitrary standards or rules on bodies, outlining their behavior, ways of being, among other aspects (Louro, 2014). Because we live in a sexist and patriarchal society, we are presented with a single way of constructing our sense of identity, including gender identities. Men are given certain ideal characteristics, such as being able to relate to any girl, thus being classified as "studs", while women who show similar behavior are labeled as "shameless". It can be seen that these roles were reinforced in the course participant's narrative, showing that mathematics can (re)produce gender stereotypes, as well as reinforcing the male/female binary that needs to be broken down. This will therefore be the topic of the second subsection.

Finally, we will understand the means by which scenarios of prejudice can be perpetuated, considering **pedagogical practices and materials as (non-)enhancers of normalization processes**. Particularly in this case, it is clear how an environment designed to discuss mathematics in a supposedly neutral way mobilized socially and culturally constructed conceptions of sexuality. More specifically, the way in which the idea of function was introduced supported (and reinforced) compulsory heterosexuality, i.e. the social injunction for subjects to relate sexually and affectively to people of the opposite sex/gender (Butler, 2020).

View of Mathematics as a Restricted or Neutral Field

[...] It's common to observe that many people believe that because mathematics is an exact science, it shouldn't raise other issues, such as those related to living together in society. I hear from students that mathematics is just about memorizing and applying formulas. At this point I always ask: but did you know that the great mathematicians were also philosophers? Mathematics cannot be dissociated from critical thinking. To develop mathematical thinking, we have to look beyond the numbers. (E37)

As previously reported, the "hard" sciences, in particular mathematics, have been illusorily conceived throughout their historical construction as exact, neutral and objective fields. Based on these conceptions, "a mechanism is built that supports the power of mathematics to be considered as the producer of definitive and unbeatable knowledge in discussions" (Mendes et al, 2022, p. 30), especially considering debates of a social, political and cultural nature. However, due to the socio-political turn that we have been experiencing, these ideals have been under strain and it has become increasingly clear that these sciences are crossed "by the intentions of a Eurocentric part of society that aims to maintain its *status quo*". (Guse & Esquinalha, 2022b, p. 2)

[...] we have to see mathematics not just as an exact science, but as humanistic, open not just to calculations, but involved in social and cultural issues, a place for everyone. (E20)
[...] one problem I've noticed is that the standards for teaching mathematics have shaped my thinking in a certain way to see this subject as "neutral" in relation to social issues, which is why I'm still trying to break away and open my eyes to the gender stereotypes present in the way this subject is taught. (E42)

These two reports are just some of the ones in which the course participants showed that they recognize the need to definitively break with hegemonic discourses that place mathematics in a position of neutrality. The first report brings up the idea that we should go "beyond calculations" and involve mathematics in social and cultural issues. The second, on the other hand, highlights how social discourses shape us to believe in the pseudo-neutrality of mathematics. With regard to the first, in fact, we have a conception that mathematics, being a science directly associated with numbers, is not imbued with social issues. However, we know that this is a fallacy.

Débora Souza-Carneiro's research (2021), when carrying out a case study with students from public higher education institutions in São Paulo, puts a strain on the idea of the neutrality of mathematical knowledge by debating which factors are considered when thinking about compensation amounts that people should receive due to accidents. Although some people lose more than others or even need more than others, these amounts are often calculated based on the interests and priorities of the paying company, quantifying the value of a life. Let's take a look at the account of one research participant:

[...] if a bricklayer or an engineer died during the landslide, they will analyze how much that person contributed, or perhaps how much he could contribute until his retirement. In these cases, the compensation would be based on that, not on the values and everything they represented, but on how much they could contribute to society. So, if we think about it like this, someone who earns little would earn almost nothing, you know? and an engineer who might have had a better, more peaceful life, even if he had the means, the compensation for his death would be very high... (Souza-Carneiro, 2021, p. 236)

Given this account, can we really think that calculations are not imbued with intentions? That mathematical knowledge is neutral and escapes social, political and cultural debates? Souza-Carneiro's account (2021) makes explicit the tool-like nature of mathematics, which was used in an attempt to quantify the "value" of a life. This "value", however, does not refer to ethical or moral principles, but rather to the arbitrary stipulation of a "price" to be paid for a body that will no longer be able to work. Thus, in this case, neoliberal principles have found in mathematics an efficient means of propagating their unequal distribution of value to bodies.

Another purpose that is usually attributed to mathematical knowledge refers to the delineation of those who are considered intelligent and those who are not (Esquincalha, 2022). Researcher Rochelle Gutierrez (2013) shows us how mathematics can occupy a position of superiority in relation to other disciplines and be considered a substitute for intelligence. This fact is corroborated even when we see policies in various countries that "tend to privilege mathematics and science to the detriment of other school subjects, considering the latter irrelevant to current social and productive needs" (Valero, 2018, p. 50).

The notion of the superiority of mathematics means that it is considered a privilege for specific bodies and, even when other bodies manage to occupy this space, the scenarios of discrimination produced by the discipline itself do not cease to occur. Guse & Esquincalha (2022b), in a survey of LGBTI+ math teachers, show us how mathematical knowledge can be used to protect those people who are said to be "good at mathematics", but which nevertheless segregates, excludes and is used as a device for establishing/maintaining power.

I think that the students don't feel that math is for everyone. On the contrary, they still resist learning because they believe that mathematics is for the few. And that's exactly where including gender issues, social issues and other important issues can add a lot to this discussion: making mathematics more human. (E7)
[...] I believe that the perception of mathematical learning being the privilege of the most "intellectually gifted" people is still very much reinforced and that this strengthens this prejudiced thinking. (E13)

We have a scenario of exclusions that also occur in mathematics and validate which bodies can occupy its spaces. The segregation associated with mathematical knowledge means that "those who are recognized as skilled in mathematics have more value than others who, in turn, are devalued" (Guse, 2022b, n.p.) and aptitude for the discipline makes those who do not align with these expectations doomed to failure.

In view of the discussion presented here, it is urgent that we deconstruct the supposed neutrality attributed to mathematics, especially given the perverse consequences it entails. The course participants' accounts and the examples presented show how much the idea of mathematics as a "neutral field" - and therefore disassociated from social and political discussions - contributes, on the one hand, to masking dishonest interests and, on the other, to keeping it inaccessible to certain social groups.

The character of a discourse of truth (Foucault, 2014), resulting from the assumption of neutrality, makes mathematics susceptible to being mobilized by certain social groups as a tool to justify - and legitimize - their privileges and, at the same time, devalue and dehumanize those

who do not enjoy the same social status. In this case, "neutrality" serves as a shelter for dubious interests who, in turn, use it as a way of making themselves invisible by claiming that "there is no interest behind mathematical knowledge".

In addition, the assumption that mathematics is a neutral area of knowledge usually implies that it is susceptible to learning by anyone, regardless of the social markers it may have. However, this is a fallacy, given that among the various groups historically excluded by the discipline are women. After all, "masculinity operates as a deeply rooted metaphor for reason" (Hottinger, 2010, p. 56), a characteristic that is discursively attributed to mathematics and which will be discussed in the next subsection.

Gender Dynamics in Mathematics

The debate on gender and sexuality issues and the teaching of mathematics is an extremely necessary step, given that, most of the time, the school consolidates these gender stereotypes, excluding a good portion of its students, separating people into two groups and overvaluing one of them with this culture that men are better at calculations and the rest end up being inferior due to a distorted version of knowledge. (E23)

The discourses produced about mathematics organize and categorize ideas about the types of people who can do mathematics, as well as the ways of learning it, teaching it and producing it. For Mendick (2006) such ideas "[...] organize notions about natural abilities and hierarchies of knowledge, and are held in place by a pattern of oppositions that defines mathematics and links it to an oppressive system". (p. 157).

According to Mendick (2006), the binarisms that structure mathematics - as objective (and not subjective), rational (and not emotional), and so on - link it to masculinity. As a result, anyone who escapes what is socially defined as "masculine" can end up moving away from the discipline, especially women, regardless of their math skills.

There is a close association between masculinity and reason, whereby masculine traits are considered central to the activity of reasoning - logic, neutrality, lack of emotional connection and separation between the knower and the object of knowledge. Similarly, reason is also often constructed as an absence of stereotypically feminine traits - empathy, creativity, intuition, embodiment and connection (Hottinger, 2010, p. 56).

Several factors contributed to the establishment of this association between mathematics and masculinity. Schienbinger (2001) reminds us that this subject was not only numerically dominated by men - women were prevented from accessing these higher education courses - but that the attributes considered appropriate and essential for its study were classified as "masculine".

[...] even though women are present in the academic community (albeit in low numbers in areas considered "harder"), there are few female professors/scientists who have become so recognized compared to their colleagues in departments, universities, etc. (E8)

In a social world organized around the male-female binary - understood as opposing and mutually exclusive poles, whose attributes would be **naturally** determined - it remained for women to be classified as "naturally" unsuitable for scientific activity, in a kind of limitation imposed "by nature" (Schienbinger, 2001). Furthermore, the social attributes linked to the female gender and mathematics are often considered antagonistic, as we have seen in some of the course participants' speeches.

The research shows that there were/are definitions in which the male gender stands out over the female, placing the former as intelligent, focused and other adjectives that magnify them. The female as dedicated, inattentive and delicate. (E26)

The reflections in the text about teachers thinking that boys are better than girls I experienced during my undergraduate studies, with a teacher who said that women had to look after the house, didn't ask women questions about the content, among other things. [...] (E31)

This is a false truth that many still believe, that a woman's place is not in the exact areas and technologies. How difficult it is for a woman to choose to be in these areas and how even more difficult it is to pursue a degree, a master's and an academic career, given the many obstacles along the way. (E33)

As a consequence of this perception of inadequacy between "being a woman" and "doing mathematics", many girls and women come to believe that this field of knowledge is not suitable for them and so give up on a possible career in the area, as we see in the following report.

In my classes, I see many girls who don't feel confident about learning mathematics. I believe that this may be due to a long history of frustration that they carry with them throughout their school life, seeing many teachers placing boys as the protagonists and as more concentrated/focused students. (E40)

On the other hand, there are still girls and women who, despite all the adversities they face during their education, insist on continuing in mathematics-related courses. However, given the extremely sexist and exclusionary culture they encounter in these departments, the misogyny they suffer is not uncommon, even when they occupy teaching positions.

[...] I work in higher education and I still notice a certain resistance from male students to validating my speeches or being tutored by me, for example. As I'm the only female lecturer in my department, male students end up looking for male lecturers and the women end up looking for me. (E11)

[...] At various times, we've noticed students resisting validating what the female lecturers say during classes. (E12)

[...] During a conversation with a professor at my university, she told me about a very similar situation that I was thinking about, where men (professional colleagues) always seemed to have to validate comments made by women, whether in simple informal conversations or even department meetings. Furthermore, she reported that lower positions that don't have as much direct contact with the dean's office or higher positions are held by women, while the higher positions are held by men. (E13)

In this last report, in addition to the disqualification of the teacher's speeches - which in itself would constitute a type of gender violence - it is also possible to see a case of **institutional segregation** (Schienbinger, 2001); that is, the teacher in question being prevented from occupying certain spaces where power is exercised - or in fact having the opportunity to express her opinion when in these spaces - solely and exclusively because she is a woman.

We could extend this discussion even further by noting that not all performances of masculinity are legitimized for doing mathematics; only **hegemonic** performances of masculinity are authorized to pursue this scientific endeavor.

[...] In our society, the ideology of hegemonic masculinity defines standards of behavior to be followed by men and is structured on the basis of asymmetrical relations between genders. Although this ideology constructs discourses with the intention of subordinating women and devaluing everything that refers to the feminine, they are not necessarily, or in their entirety, directed at women, but also at the other, the man, the real and potential opponent. (Bento, 2015, p. 91)

From this perspective, men who may not fit into hegemonic masculinity, such as cisgender gay men or trans men, as well as non-binary people, cisgender or trans women - regardless of their sexual orientation - among other gender and sexual dissidents, may not see themselves as people capable of doing mathematics. Furthermore, even when they insist on pursuing this area of study, they may feel coerced into not expressing their sexuality or making it an object of discussion in their work. This perception is clear in some reports.

I'm homosexual and I can tell you that even within the scientific world we have to be careful with the title of our research, for example, because if it contains something like the acronym LGBTQIA+ it may not be approved by the boards or it may be viewed badly within the academic world. (E48)

[...] I've seen some of my colleagues who have stopped working on topics associated with the LGBTQIA+ community or politics, for example. I don't judge them, because I know how difficult it is to put such delicate subjects into a plan that will be analyzed by people, because this evaluator may be more open to these topics or completely against any topic that deviates a little from "Traditional Mathematics". (E49)

Furthermore, another point to be highlighted is that discourses of binary oppositions about mathematics can also validate a binary structuring of other social issues, such as gender

binarity. In the binaries established by Mendick (2005), the term with the "highest value is associated with masculinity and the second with femininity", making invisible those people who do not understand themselves in a binary opposition, such as non-binary people.

[...] in some questions in [math] books, women are represented as mothers, housewives, cooks and men are represented as engineers, scientists, athletes. In addition, many questions that ask for a separation by gender (for example, asking for the percentage of men and women in a given event) perpetuate the dichotomy of men versus women and don't even consider the existence of people who are neither men nor women. (MD30)

Based on the above, it is necessary (and urgent) to recognize these differences (Healy & Powell, 2013) so that we can break with these binaries that structure mathematics, as well as destabilize the power relations that underlie them, (re)constructing discourses produced about it and problematizing its teaching and learning processes, as well as the teaching materials used in this process.

Pedagogical Practices and Materials as (Non)Potentiators of Normalization Processes

Mathematics must lose this concept of neutrality for teachers and begin to include in its content images, illustrations, statements that deal with genders, races, women acting outside of home spaces, no longer reinforcing this hidden curriculum that insists on placing the cis gender in outdated standards and not giving visibility to other genders (MD20).

One of the possible ways in which stereotypes are (re)produced in/by mathematics is through the practices and materials used in everyday classes, such as textbooks. These should be used "as an instrument of (trans)formation and conduction of subjects' and society's behavior" (Santos, 2019, p. 12). However, research in the field of Mathematics Education (Durval & Esquincalha, 2022; Neto & Pinheiro, 2021; Godoy et al., 2020) has shown that some textbooks reinforce stereotypes about certain bodies and make others who escape social norms invisible.

[...] still in the 21st century, we have to think about the lack of equity in teaching materials, whose function was to help teachers build this thought of equity with their students, but which only reinforces stereotypes, going against what is expected. (MD20)
[...] I've used a lot of didactic material with sexist language and most of it is what arrives at schools for teachers to use and most of the time we're not aware of it. (MD2)

In the same way that we recognize the non-neutrality of mathematics, the materials used to teach it can also be means for the (re)production of hegemonic discourses in our society. According to Oreste Preti (2010), textbooks have several positive aspects, such as the fact that they are structured through the written word, which "stimulates the formation of images and evokes metaphors whose meaning depends, above all, on the imagination and experience of the

reader" (p. 12) or even the possibility of "multiplying the teacher's action to reach [an] increasing number of students" (p. 13). However, it was (and perhaps still is) used as an instrument of control.

According to the author, the textbook, in its history, has contributed to the capitalist project on the Brazilian scene, being conceived as a "strategy of disciplining, of training to submission, to what is pre-determined, pre-written" (p. 14). Furthermore, during the military dictatorship, the "textbook industry also acted as an instrument of ideological control, disseminating a certain vision of the world and of Brazilian society that conformed to the imposed system" (p. 14). Thus, we can see how the textbook has acted as a vehicle of normalization that (re)produces the ideals of those who are occupying spaces of power. And this is no different for gender and sexual issues.

[...] Opening the textbook, the images/illustrations of people in general reinforce the expected gender roles. Women are illustrated as consumerists, related to examples of beauty, aesthetics, motherhood and domestic chores, while men are illustrated as rational/intellectual, strong, leaders, providers and independent. (MD13)

[...] one factor that can influence this is textbooks, which sometimes portray masculine mathematics as something extradomestic, imposing and respectful, such as dealing with money or bank accounts, and feminine mathematics as domestic, which is only useful for the home and caring for children and spouses, such as knowing the dosage of a medicine or a cake recipe. (MD17)

Textbooks, particularly mathematics textbooks, can reinforce gender stereotypes by containing only pictures that reinforce the socially defined roles of men and women. In addition, they also contribute to the preservation of the male-female binary and aspects associated with sexuality by having, in their representations, only these two ways of expressing gender and traditional (heterosexual) family compositions.

Researcher Anna Lydia Durval and researcher Aginaldo Esquinca (2022), when analyzing Brazilian theses and dissertations with the aim of identifying the issues surrounding gender relations in mathematics textbooks, show us how these materials are still structured from a discriminatory perspective.

On the one hand, when apparently free of stereotypes, gender inequalities are silenced. On the other hand, despite years of social struggles and even with national programs regulating the quality of textbooks, stereotypes of femininity, masculinity and generalized conceptions of the female and male body are still easily found illustrated or described in mathematics textbooks, in addition to the non-existent representation of non-cis-heteronormative gender and sexual identities. It can therefore be seen that the perspectives on gender in society are reproduced in these materials, which are apparently free of subjective ideologies. In this way, such representations are

perpetuated in the generations disciplined in the school environment, even in the 21st century. (Durval & Esquincalha, 2022, p. 371)

We must always remember that textbooks are produced with the aim of pleasing potential buyers of this material. Although the National Textbook Program (PNLD) regulates its production, there is still a need for the material to be well accepted. In this sense, publishers aim to "effectively observe the discourses that echo" (Santos, 2019, p. 136) both in the school environment and in society and "reproduce them in the textbook, in order to produce a suitable, saleable, profitable book" (p. 136). In short, considering the interest of selling the material, it is necessary to (re)produce the social norms in force so that the textbook meets social expectations.

Publishers need to please the schools that are potential buyers and end up following a traditional model for greater acceptance and consequent sales. I don't know how to resolve this issue. Perhaps in the extra exercises I do, in my behavior and in my way I talk to the students, the seeds will be planted and through them, taken to the families, in an unfortunately long process, but one that needs to begin. (MD7)

Unfortunately, education is becoming a business, with private schools and some federal schools working as a network, using the same material and setting the same assessments. In this way, publishers are looking to make a profit and stopping the traditional system already in place is unlikely to be done spontaneously. One more positive factor in taking this course is being able to broaden our vision and increase the number of members in the fight for change. (MD8)

As portrayed in these two stories, we cannot simply allow ourselves to be manipulated by the current scenario. We need to resist the regimes of surveillance that try, at every turn, to fit people into systems of normalization in search of educational practices in mathematics that are emancipatory, especially in relation to groups that have historically been marginalized by mathematics.

[...] if we come across discourses and gender roles in our textbooks that are somehow exclusionary or reinforce this idea of heteronormativity, attacks on LGBTI+ people and prejudice, we could discuss this issue with our students and propose another solution or even a reorganization of the ideas presented in the textbook. What's more, we could use this "error in the book" to do in-depth research on the subject with our students, with the aim of building new knowledge using information that was given incorrectly. (MD1)

The other day I had to solve a set problem with the students, and the problem simply assumed that there were only men and women, and when it came to solving it, I made it clear to the students that we would solve it that way to get the answer, but that in practice we can't consider in a group that there are only men and women, it completely excluded non-binary people and other genders. There was another exercise, this time in combinatory analysis, where it was about forming couples and to get the answer, it was considered that couples were only men and women, and at the time of solving I said the same thing to the students, that we would solve it that way to get the answer, but that in practice, there were other types of couples in there that could be put together. (MD15)

The reports presented above show us how important it is for us to engage in finding strategies to counteract the overwhelming effects of mathematics (and its teaching). We must move towards a queering of textbooks, as well as the ways in which we teach mathematics, so that we can escape from normalizing patterns and go against what has been hegemonically established (Guse, 2022a).

Considerations

I heard from an undergraduate professor that Mathematics Education was "playing with straws and playdough" and we know that most people agree with this idea. How can we open up spaces for more humane debates in such a hostile environment?" (E28)

The view of Mathematics Education as a field that should be limited to studying the teaching and learning processes of a single technician, objective and neutral Mathematics still resides in the imagination of many mathematicians and even mathematics educators. However, here we seek to go further: we aim to glimpse the different mathematics that emerge in the most diverse social practices and that enable us to put a strain on what has hegemonically penetrated our knowledge and our bodies.

The aim of this production was to analyze the discussions in a forum of the course "Gender Studies: what does Mathematics have to do with it?", about the possible stereotypes that Mathematics can (re)produce with regard to people who dissent from gender and sexual norms, with the aim of queering the pseudoneutrality that has been discursively constructed as inherent to the discipline over the years. To this end, we subcategorized our analysis into three axes: (i) the view of mathematics as a restricted or neutral field, (ii) the dynamics of gender in mathematics and (iii) pedagogical practices and materials as (non-)enhancers of normalization processes.

In each axis, we articulate the course participants' statements with theoretical foundations that verify how the teaching of mathematics still perpetuates stereotypes of normalization that inferiorize and make invisible people who belong to historically marginalized groups, especially with regard to bodies that dissent from gender and sexual norms, but not only.

Throughout the first thematic axis, we question the pseudo-neutrality often attributed to mathematics, bringing examples of how this discipline can be mobilized as a tool for

perpetuating shady and questionable interests. In addition, we argue that the teaching of mathematics cannot be conceived under an ideal of neutrality, especially when considering its use as a supposed indicator of students' intelligence, which leads to various forms of (self-) exclusion.

In the second thematic axis, we gave examples of how the subject, as well as the situations that are usually encountered in the classroom, contribute to the perpetuation of gender stereotypes. We outlined some considerations about how these stereotypes prevent (or hinder) access to the study of mathematics for certain people due to possible social markers, as well as reproducing broader social gender and sexual patterns.

The third thematic axis was concerned with addressing the role that teaching materials, especially mathematics textbooks, play in the (re)production of normalizing patterns of gender and sexuality. We argue that, despite the potential help they can provide to classes, these teaching resources are designed to fit in with broader hegemonic discourses, since they need to be accepted in order to be sold. However, we emphasize that this does not prevent teachers from developing strategies to question, subvert and queer the teaching of mathematics through these materials, which also constitutes them as an object of dispute and a locus of resistance.

We still have a long way to go to make math teaching less exclusionary for these people. However, long paths are only completed if we start the journey and overcome all the barriers along the way. In this way, we need to remain strong and continue to break with the (re)production of discriminatory processes that occur in/through mathematics in order to envision diverse mathematics that encompasses multiple forms of existence. With this, we end this production with the words of a course participant who summarizes our future paths and shows that we are not alone in this struggle.

As teachers, we play an effective role in the construction of our students' critical thinking, so even if only minimally, we need to mediate situations, always linking assertive, inclusive practices to our teaching routine and combating any form of segregation or prejudice. In this sense, we need to understand that, even unconsciously (or consciously), our discourse encourages thoughts, attitudes and behaviors to be rethought, and it is at this point that we will make a difference and transform the school/classroom into a welcoming environment that promotes equity, thinking about activities that change the standard imposed on us, where respect for all prevails. (E30)

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This article was translated by Silvia Iacovacci.