

ANALYSIS OF THE EDUCATIONAL POSSIBILITIES OF THE THEME OF BLACK WOMEN IN MATHEMATICS

ANÁLISE DAS POSSIBILIDADES EDUCACIONAIS DO TEMA DAS MULHERES NEGRAS NA MATEMÁTICA

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ABSTRACT

This article examines the experience of carrying out an educational presentation of scientific dissemination on the participation of black women throughout the history of mathematics, for high school students who visited the Campus of Caraguatatuba of the Federal Institute of São Paulo (IFSP), in May 29, 2023. Therefore, this work articulates research, teaching and extension, in an interdisciplinary way, with the aim of examining the pedagogical possibilities of the thematic axis of black women in mathematics. To support the investigation, a theoretical review was carried out on this subject, through the search for academic works on the subject, using, for this, the “Google Scholar” tool. A questionnaire, which was designed to ascertain the views of those present on the topics covered, was answered by 15 high school students who attended the presentation. The results of this research point to the importance of the concept of intersectionality that takes into account gender, race and class identities when investigating the trajectories of black women who are professionally dedicated to mathematics, as researchers and educators.

Keywords: Gender. Race. History of Mathematics. Diversity.

RESUMO

O presente artigo examina a experiência da realização de uma apresentação educacional de divulgação científica sobre a participação de mulheres negras ao longo da história da matemática, para alunos de ensino médio que visitaram o Campus de Caraguatatuba do Instituto Federal de São Paulo (IFSP), em 29 de maio de 2023. Desta forma, este trabalho articula pesquisa, ensino e extensão, de modo interdisciplinar, com o intuito de examinar as possibilidades pedagógicas do eixo temático das mulheres negras na matemática. Para fundamentar a investigação foi realizada uma revisão teórica sobre esta temática, por meio da busca de trabalhos acadêmicos a respeito, usando, para isto, a ferramenta “Google Acadêmico”. Um questionário, que foi elaborado para averiguar as concepções dos presentes sobre os temas abordados, foi respondido por 15 estudantes de ensino médio que assistiram à apresentação. Os resultados desta pesquisa apontam para a importância do conceito de interseccionalidade que leva em conta as identidades de gênero, raça e classe quando se investigam

as trajetórias das mulheres negras que se dedicam profissionalmente à matemática, como pesquisadoras e educadoras.

Palavras-chave: Gênero. Raça. História da Matemática. Diversidade.

Introduction

This article aims to examine an educational extensionist presentation on the participation of black women in mathematics throughout history. This presentation took place on May 29, 2023, in the auditorium of the Campus Caraguatatuba of the Federal Institute of São Paulo (IFSP), the institution where the two authors of this article work. It was held for high school students from a state school who were visiting the IFSP at the time.

After the introduction, the theoretical foundation of the research – dealing with issues related, for example, to affirmative action and the presence of black women throughout the history of mathematics – is presented, which was carried out from the reading and systematization of academic works on the thematic axis in focus, using the “Google Academic” search tool. Subsequently, the methodological procedures used to carry out the presentation are analyzed. Next, we describe and discuss the results that were obtained from the responses provided by the high school students present during the presentation, to a questionnaire previously prepared with the aim of knowing their conceptions, perspectives and knowledge. At the end, the final considerations are made, with reflections on all the work carried out.

Affirmative Action

At the beginning of this article, it is important to reflect on the importance of affirmative actions, something fundamental when studying the presence of black women in mathematics. Affirmative Action involves sets of policies and practices to include groups (black women, for example) that were historically discriminated

against in areas – such as education and employment – in which such groups are underrepresented or suffer from lack of public support.

The implementation of the right to equality is a fundamental task for democracy, which ultimately means equality in the exercise of civil, political, economic, social and cultural rights. Therefore, to implement the right to equality and overcome the harmful legacy of centuries of racial and social inequalities, it is crucial to intensify affirmative actions, combining promotional strategies with the aim of accelerating the process of building racial equality (SANTOS, 2007).

Regarding the panorama of affirmative actions to promote the development of black women in science in Brazil, some actions with this purpose have emerged, but still timidly given the racial and gender inequalities that are until now very large in our country. In 2023, the federal government launched a postgraduate scholarship program abroad exclusively for black, indigenous, quilombola and gypsy women (SILVA, 2023). Also in 2023, the state of Rio de Janeiro, FAPERJ (Rio de Janeiro State Research Support Foundation) and the Serrapilheira Institute selected scientists in an exclusive call for black and indigenous people with the aim of ensuring that more people from underrepresented groups can be formally integrated into academy as university professors and researchers (FAPERJ, 2023).

Currently, in Brazil, even with the percentage of black people being more than half of the Brazilian population, the science produced is still mostly white: on average, only one in four enrolled (25%) in master's and doctoral programs is black. This conclusion was obtained from a 2018 open database from CAPES, an agency focused on postgraduate studies in Brazil. The demographic profile of postgraduate studies is important because scientists in training taking master's and doctorate courses produce a large part of the national knowledge (RIGHETTI; GAMBA; BOTTALLO, 2020). Therefore, black people in general (and black women, in particular) are underrepresented in the Brazilian academic universe.

Racial quota policies play a pivotal role in dismantling historical barriers and fostering greater diversity within higher education, particularly for black women. These policies address systemic inequalities by ensuring proportional representation, thereby affording women of color equal access to educational

opportunities. For black women, who often face intersecting challenges of gender and racial discrimination, racial quotas serve as a means to rectify longstanding disparities. By creating a more inclusive admissions process, these policies not only promote social justice but also contribute to the enrichment of academic environments through a diversity of perspectives and experiences.

In general terms, in 2022, according to data from INEP (2023), brown or black students corresponded to 37.0% of the total number of higher education students in Brazil, with 21.8% being brown or black women and 15.2% being brown or black men; in addition, white women made up 24.3% of the total and white men made up 17.1% of the total, corresponding to 41.4% of white students of both genders. In turn, also in 2022, among those completing higher education courses in Brazil, brown or black people made up 38.3% of the total, with 23.5% being brown or black women and 14.8% being brown or black men; furthermore, among the graduates, white women made up 27.7% of the total and white men made up 18.0% of the total, corresponding to 45.7% of white graduates of both genders.

Black women in mathematics

To base this research work, studies were analyzed on the presence and influence of black women in mathematics, on the stereotypes and prejudices that seek to make them invisible, and on the contributions and difficulties faced by them throughout history.

The review of the existing scientific literature on the central thematic axis of this research made it possible to examine the challenges faced by black women to access mathematics education and become professionally involved in this field, as well as to know how they influenced the development of this area of knowledge. The discussion about the importance of studying the participation of black women in the history of mathematics contributes to a more complete and accurate understanding of mathematical knowledge, challenging the traditionally dominant narrative. Recognizing and celebrating the achievements of black women in mathematics is critical to promoting diversity, inclusion and equity in this field and to inspiring

future generations of black women to pursue careers in mathematics and other areas of the exact and technological sciences: the debate on the importance of including and recognizing black women in mathematics enriches understanding of this field and offers broader and more complete perspectives.

The history of mathematics is largely dominated by narratives that highlight almost exclusively the contributions of white men, leaving aside the presence and significant achievements of women, especially black women. This historical marginalization results in a distorted perception in the general public of black women's participation in mathematics, leading to under-representation and an erasure of their contributions and achievements. When children are not exposed to scientists – for example, in the area of mathematics – who seem like them, this creates a lack of role models that makes them not see themselves as scientists in the future (JONES, 2019).

There is a limited amount of research on the mathematical experiences of black women (DAMES, 2016), which, as political subjects, are the result of historical, social and cultural demands, and of facing of adverse conditions established by the eurocentric hegemony over the centuries of slavery, by colonial expropriation and by patriarchy: the heterogeneities produced arise from the diversity of worldviews and experiences, from the African diaspora. In this scenario, the fight against the violence of annihilation, genocide and epistemicide was developed to guarantee an active participation in the determination of their living conditions (WERNECK, 2009).

History is not just limited to knowledge about what happened in the past, it can be used to help us understand the present as well as guide us towards the future; that is why it is important to study history: to know ourselves better (BOSCHI, 2019). This process of historicity implies that everything in human life and society is subject to a specific historical context: events, ideas, institutions and human beings are influenced by the circumstances and historical conditions in which they occur (COLLINGWOOD, 1981).

It is crucial to recognize and explore the importance of black women in mathematics, not only as an imperative of historical justice, but also for their

intellectual contribution and the impact they have had on the evolution of mathematical knowledge. By challenging the dominant negative stereotypes associated with them (HOOKS, 2015) and the existing barriers, black women paved the way for significant advances in several fields of knowledge. When they move, black women move the entire structure of society along with them (ALVES, 2017).

The empowerment of black women in the face of the oppressions they face and have faced is important for building a more just and equitable society (HOOKS, 1981). Understanding the complexity of black women's experiences, exchanging communications about the experiences and emotions of marginalized people, and recognizing the existing differences within a society collaborate decisively in building stronger and more united communities, capable of facing the challenges of the world. In this sense, collective action based on a sense of solidarity is a vital element for the emergence of social transformations that point to a world with more social justice (LORDE, 1984).

Among the black women mathematicians who have distinguished themselves in history are: Martha Euphemia Lofton Haynes (1890-1980), the first African-American woman to obtain a PhD in mathematics; Gloria Ford Gilmer (1928-2021), a leader in the field of ethnomathematics; Grace Alele-Williams (1932-2022), the first female vice chancellor of a university in Nigeria; Vivienne Lucille Malone-Mayes (1932-1995), the first black professor at Baylor University, an institution that had previously rejected her as a student due to its policy of racial segregation; Lillian Katie Bradley (1921-1995) who became Associate Professor of Mathematics at Texas Southern University; Kate Adebola Okikiolu (1965-), the first black woman to win, in 1997, the most prestigious award for young mathematics researchers in the United States, the Sloan Research Fellowship; Eliza Maria Ferreira Veras da Silva (1944-), the first black Brazilian woman to obtain a doctorate in mathematics.

It is necessary to point out that many black women are often described as educators rather than scientists or mathematicians, despite the fact that they often have long careers as researchers. In the United States, specifically, one of the reasons for this to occur is the fact that the black community gives great prestige to

educators who constitute a professional area considered honorable for blacks to ascend socially (WARREN, 1999).

The concept of intersectionality is crucial for this research, as it is a useful theoretical and methodological framework for studies on the participation of black women in STEM areas, that is, Science, Technology, Engineering and Mathematics (IRELAND *et al.*, 2018). Historical knowledge about the intersection between gender, race and class allows us to understand how systems of oppression intertwine and specifically affect black women (DAVIS, 2016). The consideration of all existing dimensions in the analysis – including the recognition of diversity within the group of black women with regard to their different ethnic origins, social classes and sexual orientations (HOOKS, 1981) – helps to recognize and value the voices, the experiences and contributions of these women in the fight for the transformation of unequal structures in society.

Many black women see their racial and gender identities among what stand out most about themselves. Additionally, a black woman's racial identity often takes precedence when she is in a room with white women, while, in contrast, in a room with white men, her identity as a woman may become more salient: these intersectional identities make it possible to understand how identities interact and inform each other (CHARLESTON *et al.*, 2014).

In addition to the educational systems themselves, there is, in the social sphere, a particularly hidden principle of differentiation that generally affects the poorest and the black population and which must be taken into account when analyzing the central theme of this research: “well-born” students, who have received from their families examples and advice capable of supporting them in case of uncertainty, are in a better position to apply their investments at the right time and in the right place, while those who are precedents of families devoid of resources are forced to submit at the injunctions of the school institution and at the determinations of chance so that they often invest at the wrong time and in the wrong place, a cultural capital that, anyway, is extremely reduced. This all points to a pattern of reproducing inequalities – instead of overcoming them over time – and

maintaining privileges, which means that positions of power continue to be exclusive, as they were in the past (BOURDIEU; CHAMPAGNE, 1998).

Finally, it is necessary to highlight, as evidenced by several surveys, that it is important to broaden the voices and perspectives in different academic areas: the knowledge produced by black women in the sciences stimulates the growth of scientific production itself. The diversity of perspectives and approaches, in general, enriches science, drives innovation and allows the resolution of complex problems in more creative ways (BENITE, 2020).

Methodology

In order to investigate the existing educational possibilities in teaching and scientific dissemination actions about the presence of black women in mathematics, a presentation on this theme was structured, which was carried out, in person, by the first author of this article, for high school students from a state school in the municipality of Ubatuba (a city located on the north coast of São Paulo), during a visit that these students made to the Caraguatatuba campus of the Federal Institute of São Paulo (IFSP), also located on the north coast of the state of São Paulo.

To carry out this extensionist activity, a presentation file was prepared (using the Powerpoint program) with a series of slides on the importance of black and female representation in the history of mathematics, mentioning, in particular, the history of racial segregation that existed in the United States in the context of the Space Race against Soviet Union in the 1960s. The presentation was held in the auditorium of the IFSP-Caraguatatuba, within the scope of a set of some other scientific dissemination presentations made in sequence for the same visiting public, on May 29, 2023, in the afternoon period.

The visit of these students (accompanied by two of their professors) was organized by the second author of this work and had as objectives both that they get to know the IFSP-Caraguatatuba campus and its courses, and that they are encouraged to be interested in the history of science and in scientific issues in areas of physics and mathematics, for example; in this sense, as the IFSP-Caraguatatuba

hosts an Undergraduate Course in Mathematics (in the morning) and an Undergraduate Course in Physics (in the evening), during the visit, students were also informed about these two courses and how to enroll in them, in case they show interest in scientific and educational matters.

The presentation was attended by about 20 high school students from the community outside the IFSP-Caraguatatuba, in addition to two professors who accompanied them and some university students from the IFSP-Caraguatatuba who were present and made other scientific dissemination presentations for these visitors, in this same afternoon. It was planned a little more than a month in advance and the theme was chosen based on research on male chauvinism and racism in Brazil, with an emphasis on studies on the presence of women in mathematics and, more generally, in exact sciences. In all, the elaboration of the presentation that was made went through seven versions until reaching the one that was effectively used in the activity.

Initially, the first presentation mainly featured slides that introduced a brief summary of the history of several black women mathematicians who stood out throughout the history of science. In the second version, a slide with acknowledgments was added, in addition to increasing the font size of the texts for better visualization. The third version underwent standardization regarding the background colors of the slides, while in the fourth version additions and corrections were made to the information provided on the first slide that opened the presentation. In the fifth version, a slide specifically aimed at studying the racial issues involved and a conclusion slide on the subject were added. In the sixth version, the slide on racism and sexism in mathematics was split into three slides and a slide was added on the film "Hidden Figures"¹, which portrays the story of black scientists Mary Winston Jackson (1921-2005), Dorothy Johnson Vaughan (1910-2008) and Katherine Coleman Johnson (1918-2020), three NASA scientists who worked in the 1960s as human computers (because they performed calculations manually) during the Space Race between the United States and the

¹ More information about this film can be obtained in English from the link <https://www.imdb.com/title/tt4846340/?ref_=tt_mv_close> and in Portuguese from the link <<https://www.adorocinema.com/filmes/filme-219070/>>.

Soviet Union. However, this version did not contain images, something that was corrected in the next version, the seventh and final version of the presentation file.

The final version presented had: an introduction slide on the theme of black women mathematicians; a slide on the exclusion of black women from mathematics, with an image of Ruby Bridges, the first black child to attend a racially segregated school in the south of the United States; a slide with data from INEP (National Institute of Educational Studies and Research Anísio Teixeira) on the number of black women with doctorates in mathematics in Brazil and on the difference between the number of white women and black women with CNPq (Conselho Nacional de Desenvolvimento Scientific and Technological) scholarships, with an image of the mathematician Eliza Maria Ferreira Veras da Silva (1944-), the first black Brazilian woman to obtain a doctorate in Mathematics in Brazil; a slide briefly addressing three mathematicians who stood out in the area, namely: Martha Euphemia Lofton Haynes (1890-1980), Glória Ford Gilmer (1928-2021) and Kate Adebola Okikiolu (1965-), with images of them; a slide about the film "Hidden Figures" with the image of one of the posters of this cinematographic work. In addition, there were also slides with initial information, bibliographic references and acknowledgments.

The presentation lasted about 10 minutes and prioritized the most relevant data and information on the subject. On the afternoon it took place, this was the first presentation of a set of six other science dissemination presentations, dealing with different topics related to astronomy, the history of science and the female presence in Physics, all of them held for the same audience, but each given by different presenters, all undergraduate students at IFSP-Caraguatatuba. The slides were presented using a computer connected to the datashow in the IFSP-Caraguatatuba auditorium, a space previously reserved for this event.

Right after this presentation, a short questionnaire, with ten questions, was distributed to the participants in order to better understand their conceptions about the topics addressed. It contained questions about the participants' opinion about their knowledge of the topics covered and, in particular, about racism and sexism, both in Brazil as a whole and in the specific social environment of each student. In

total, 20 participants answered the questionnaire. The responses provided by the participants will be analyzed in this article.

Participants who responded to the questionnaire gave free and written consent to participate in this research, having been previously informed about it and its objectives. The questionnaire was designed with the objectives of gathering demographic information to determine the profile of the participants, as well as collecting data on their conceptions and previous experiences regarding issues related to the topics covered in the activity carried out. Due to lack of time, it was not possible to hold a debate after the presentation was made and participants responded to the questionnaire.

Results and discussion

The activity carried out and investigated in this article was a scientific dissemination presentation made in the IFSP-Caraguatatuba auditorium for students from a state school in Ubatuba on the theme of the history of black women's participation in mathematics. Questions about sexism and racism were present in the questionnaire previously prepared to examine the points of view and conceptions on the topics addressed and which was answered by the participants shortly after the presentation took place.

The sample with N=20 participants (all high school students who were visiting the IFSP-Caraguatatuba on the afternoon of May 29, 2023, a Monday, the day the presentation took place) who answered the questionnaire was obtained for convenience and, therefore, the results presented here make no claim to statistical rigor. A convenience sample is a type of non-probabilistic sampling in which individuals are selected based on their availability and convenience for the researcher: thus, the selection criterion is not random, but rather determined by the ease of access to participants. This sampling method is commonly used in research where the researcher has access to a specific group of people who are convenient for data collection. Despite being a fast and economical method of data collection, convenience sampling has limitations and can lead to non-generalizable results:

therefore, it is necessary to interpret the results with caution, taking into account the possible distortions introduced by the lack of randomness in the sampling in the selection of participants.

With these caveats in mind, with regard to the specific characteristics of the public reached by the investigated activity, the responses provided by the participants may help to indicate some trends and patterns, which may be useful for the development of new research on this topic, as well as for teachers interested in carrying out similar educational actions.

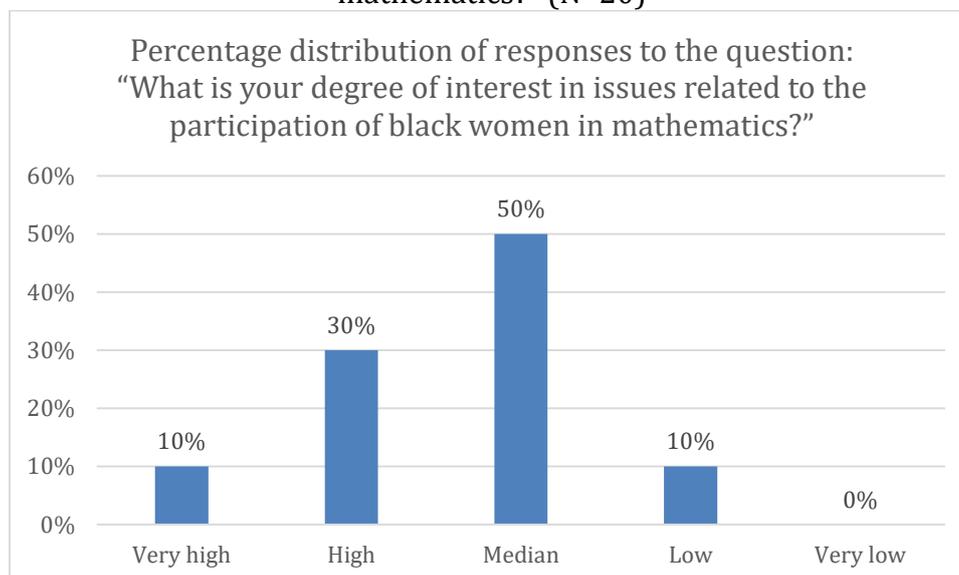
The first three questions made available in the questionnaire – and which will be analyzed below – had the objective of characterizing the profile of the public that participated in the activities in terms of age, gender and race. With regard to the age of the 20 participants, 95% (the vast majority) of them were 15 years old, with 5% being 14 years old. Regarding gender, 60% identified themselves as being male, while 40% as being female. Regarding race, 55% of the participants declared themselves white, 20% brown, 5% black, 5% indigenous, 5% yellow and 10% chose the answer “other” to this question.

The other 10 questions were related to the themes of this research and were designed with the aim of helping to understand the participants' conceptions about the participation of black women in mathematics and about the historical erasure they face. With this objective, nine closed questions (with alternatives) and one open and discursive question at the end were asked, whose answers will be analyzed below.

The first question presented to the participants, on the topics discussed in the presentation, was: “What is the degree of your interest in issues related to the participation of black women in mathematics?” The response options provided were: “Very high”; “High”; “Median”; “Low”; “Very low”. Within this context, 10% of the participants stated that the degree of their interest was very high in the subject of black women in mathematics, while 30% expressed a high degree of interest, 50% (the majority) indicated a median degree of interest, 10% reported having a low degree of interest and none of the participants claimed to have a very low degree of interest in the subject (Figure 1).

These results reveal that most participants had some level of interest – or were motivated, by the presentation, to acquire interest – in the issue of black women's participation in mathematics. This demonstration of interest on the part of the participants indicates an openness to further explore the theme and reinforces the importance of, in educational activities, addressing and promoting the history of black women's participation in the area of mathematics. The data obtained suggest that there is a significant potential for the dissemination, in the educational scope, of the participation of black women in the history of mathematics. Thus, the scarcity in the number of black women who seek higher degrees in mathematics and other areas of exact sciences, denotes the importance of implementing teaching and research programs to promote racial and gender equity in these areas of knowledge (BORUM; WALKER, 2011).

Figure 1 – Percentage distribution of responses to the question: “What is your degree of interest in issues related to the participation of black women in mathematics?” (N=20)

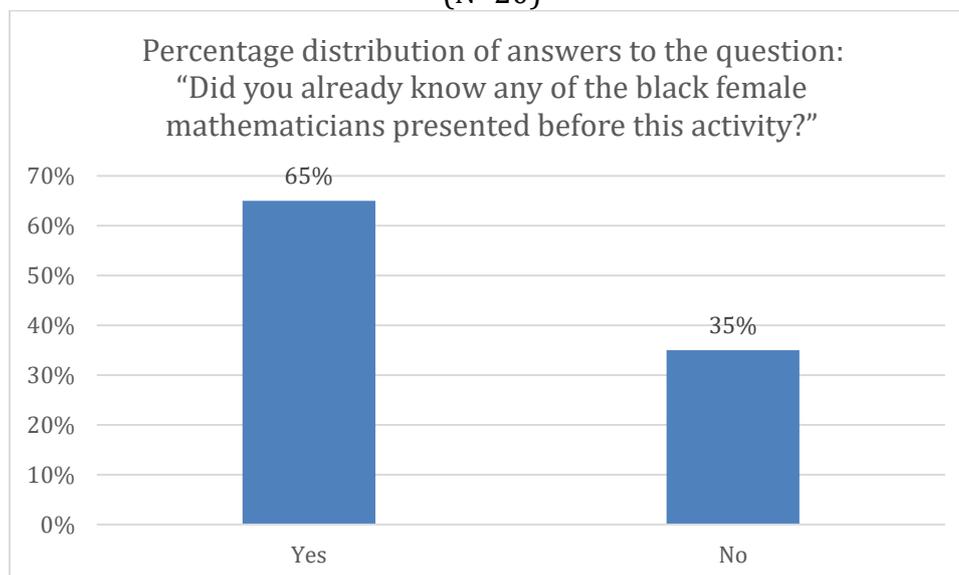


Source: Authors (2023).

The second question was: “Did you already know any of the black female mathematicians presented before this activity?” The response options provided were: “Yes”; “No”. In this case, the answers obtained revealed that 65% of the participants already had prior knowledge about some of the mathematics

mentioned, while 35% admitted not having knowledge about any of them. These data highlight that there is a significant group of participants familiar with the names of some black female mathematicians, possibly indicating a greater range of these women's history in recent times, perhaps due to the popularity of the film "Hidden Figures". The original name of this film in English, "Hidden Figures" (i.e. "Figuras Escondidas" in portuguese) indicate that the black scientists portrayed by the work were hidden for a long time, without having the deserved visibility (PEREIRA, 2020). This reveals the importance of expanding initiatives aimed at valuing the work of these women, who have historically been underrepresented in the mathematical community. Through the recognition of their achievements, it is possible to establish positive references for future generations of black girls who are interested in entering the field of mathematics.

Figure 2 – Percentage distribution of answers to the question: "Did you already know any of the black female mathematicians presented before this activity?" (N=20)

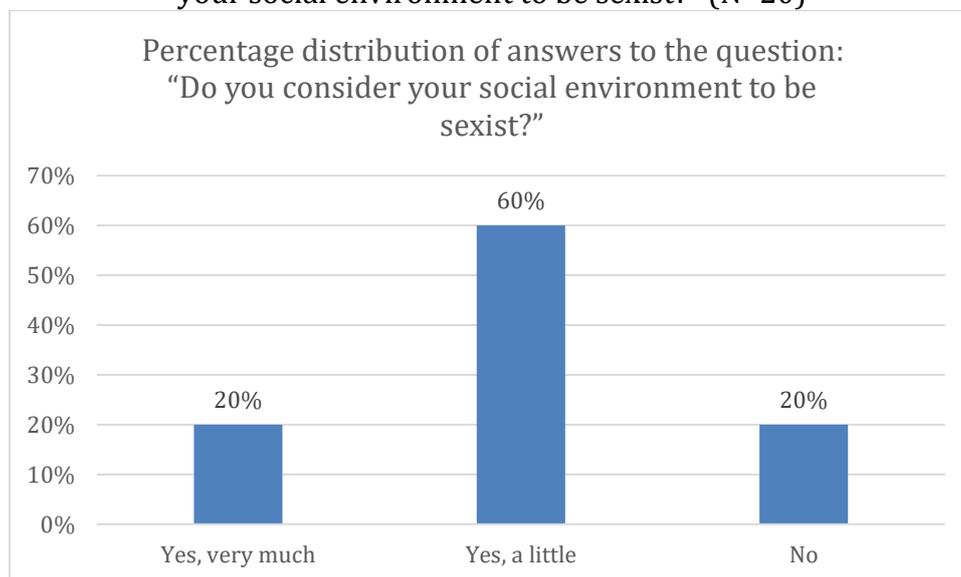


Source: Authors (2023).

The third question was: "Do you consider your social environment sexist?" The response options provided were: "Yes, very much"; "Yes, a little"; "No". The results revealed that 20% of the participants considered their social environment to be very much sexist, while 60% stated that their social environment was a little

sexist and 20% believed that their social environment was not sexist (Figure 3). This finding highlights the participants' perception of male chauvinism, at least to a certain degree, existing in their social environments. The characteristics attributed to the female gender are social constructions, and sexism is also a manifestation of this construction that permeates social contexts (BEAUVOIR, 2012): the perception and fight against male chauvinism need to take this into account, in order to be effective.

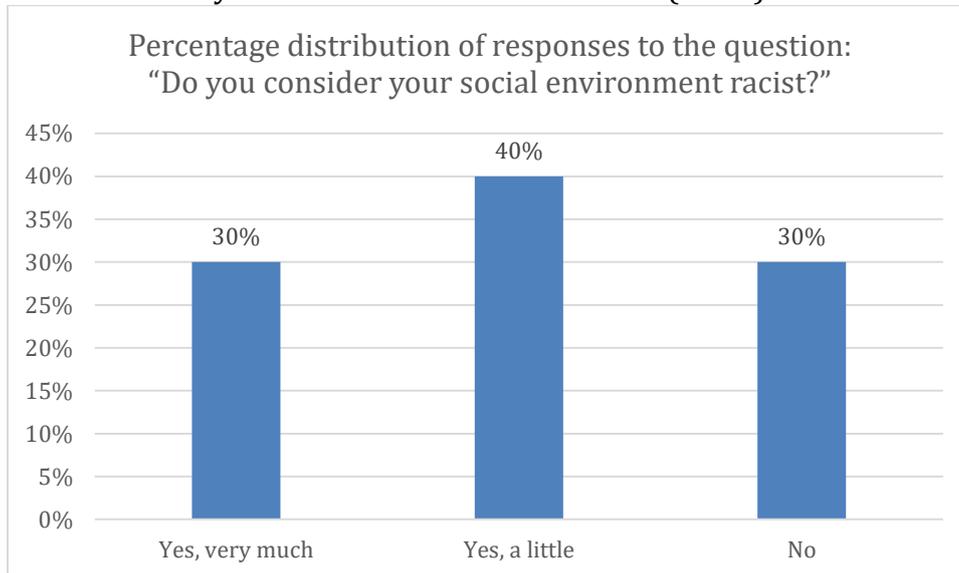
Figure 3 – Percentage distribution of answers to the question: “Do you consider your social environment to be sexist?” (N=20)



Source: Authors (2023).

The fourth question was: “Do you consider your social environment racist?” The response options provided were: “Yes, very much”; “Yes, a little”; “No”. Among the answers, 30% of the participants considered that their social environment was very much racist, while 40% claimed that their social environment was a little racist and 30% who responded negatively, stating that there was no racism in their social environment (Figure 4). These results reveal the existence of a considerable rate of perception of racism by the participants. Racism is also a social construction that perpetuates the domination and oppression of some ethnic groups by others (FANON, 2008): thus, it is important to recognize and combat racism in all areas of society, including education.

Figure 4 – Percentage distribution of responses to the question: “Do you consider your social environment racist?” (N=20)

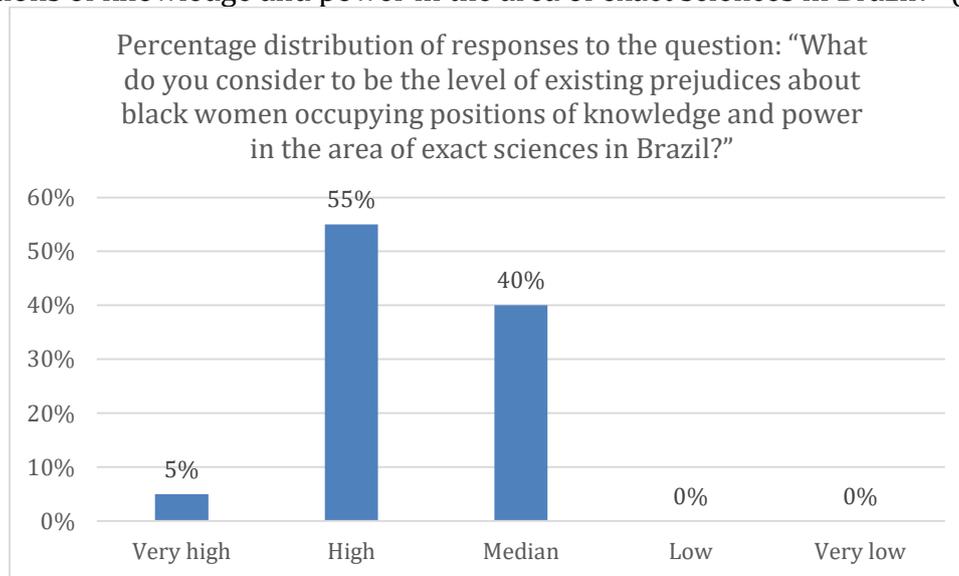


Source: Authors (2023).

The fifth question was: “What do you consider to be in Brazil the level of existing prejudices about black women occupying positions of knowledge and power in the area of exact sciences?” The response options provided, which followed a Likert scale (1932), were: “Very high”; “High”; “Median”; “Low”; “Very low”. The vast majority, 55% of the participants, considered that the existing level of prejudice is high; only 5% stated that the level of prejudice is very high, while 40% claimed that the level is median; no participant responded that the level of prejudice was low or very low (Figure 5). Such results show the participants' perception of the existence of prejudices faced by black women in the exact sciences, indicating that there is a long way to go in terms of equality and inclusion. Freedom is a constant struggle against oppression and prejudice that limit black women's opportunities in various fields, including the exact sciences; this underscores the need to promote equal opportunities for black women in areas of knowledge and power, combating existing prejudices. In this sense, it is important to consider that it is not only issues related to access to education that are relevant, but also a set of intersectional aspects – associated with gender, race and class – that show the hierarchical

relations reproduced both in society and within of the educational system itself (SOTERO, 2013).

Figure 5 – Percentage distribution of responses to the question: “What do you consider to be the level of existing prejudices about black women occupying positions of knowledge and power in the area of exact sciences in Brazil?” (N=20)



Source: Authors (2023).

The sixth question was: “Do you think it is important to have research and study organizations on the subject of black women in the exact sciences?” The response options provided were: “Yes”; “No”. In the case of affirmative answers, there was a space for the participant to write what would be the reason for their opinion. For this question, 100% of the participants answered yes, that is, that it is important to have research and organizations to study the participation of black women in mathematics, which demonstrates recognition of the relevance to promote visibility and appreciation of black women in the exact sciences. Among the written texts explaining the reasons for those who answered this question in the affirmative, the following can be highlighted: “For the simple fact that, in Brazil, it is very rare to have black women in important positions”; “Because women can learn more about their ancestors”; “Because we can learn more and reduce prejudice”; “Because black women are forgotten”; “To defend and show that rights are equal”; “Because it makes people aware of prejudice”; “Mainly to show that yes, women are

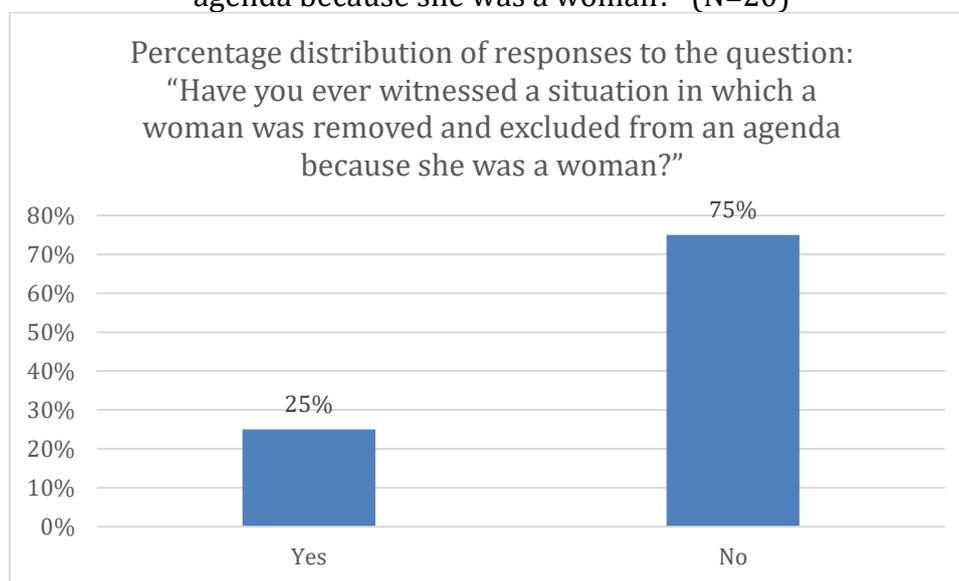
capable of doing a better job than men”; “They are part of the history of mathematics”; “It's always good to learn more”; “For female empowerment”; “This shows the importance of women in history.” To overcome the invisibility of black female mathematicians and their research work – which is often underestimated (WALKER, 2017) – it is essential that this theme be focused more intensely in research, teaching and extension activities

The seventh question was: “What do you think about prejudice against women in the exact sciences?” The response options provided were: “It is something legitimate, as women should not hold positions in this area”; “It's wrong, because women should be able to choose the profession they prefer”; “Other”. For this question, 100% of the participants also answered that prejudice against women in the exact sciences is wrong, as women should be able to choose the profession they prefer. This response shows a position of support for gender equality and freedom of professional choice, in line with the ideals of equality and female empowerment. In this sense, it is of great importance to remember that schools are legitimate spaces for confronting gender prejudices (LOPES NETA; SILVA, 2021): there is no possible neutrality in this matter.

The eighth question was: “Have you ever witnessed a situation where a woman was removed and excluded from an agenda because she was a woman?” The response options provided were: “Yes”; “No”. For those who answered in the affirmative, there was a space for them to explain how that situation had occurred. For this question, 75% of the participants answered that they had never witnessed such a situation, while 25% said they had witnessed this type of exclusion (Figure 6). These results indicate that most participants do not have direct knowledge of cases of exclusion of women due to their gender or, alternatively, they did not realize when this occurred around them. However, the existence of these cases in other social contexts cannot be denied, and the fight for gender equity remains a challenge to be faced. Among the affirmative answers, two people explained how the situation had occurred: “When you have to pick up something very heavy, men say that women are very weak”; “In the political environment, women are almost never given a voice”. Violence against women is not recent in human history. She is part of

a system that placed women in a hierarchically inferior position, producing an asymmetrical power relationship between men and women in our society. Overcoming prejudice, discrimination and intolerance is a necessary civilizing condition for life in society (SILVA, 2010): more specifically, it means fighting the condition of inferiority built from the view that considers women as a being with a lack of rationality (LIRA, 2021).

Figure 6 – Percentage distribution of responses to the question: “Have you ever witnessed a situation in which a woman was removed and excluded from an agenda because she was a woman?” (N=20)

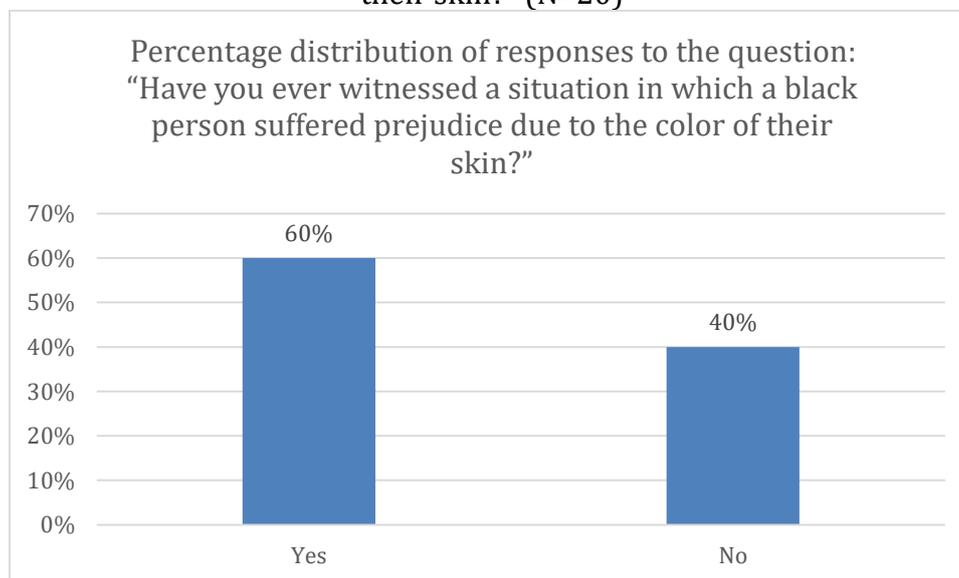


Source: Authors (2023).

The ninth question was: “Have you ever witnessed a situation in which a black person suffered prejudice due to the color of their skin?” The response options provided were: “Yes”; “No”. For those who answered in the affirmative, there was a space for them to explain how that situation had occurred. For this question, 60% of the participants answered affirmatively, indicating that they had already witnessed situations of racism, while 40% stated that they had never witnessed such a fact (Figure 7). These results point to the existence of experiences of racial discrimination witnessed by most participants, which reinforces the need to fight racism and promote racial equality in society and, specifically, in the educational field.

In the case of participants who answered in the affirmative, the texts with their explanations about the situations in which they witnessed someone being a victim of racial prejudice are presented below: “There was a student who called his teacher a monkey”; “My mother was at the market and the attendant called her a Mexican bee”; “A man was accused of robbing a store because of the color of his skin”; “Of my brother playing and his 'friends' telling him to leave because of his color”. These responses highlight different examples of discriminatory acts, such as racist insults directed at a teacher, the use of derogatory terms to refer to black people, and the exclusion of an individual due to the color of their skin. These reports show the persistence of racial prejudice in society and the need for continuous work to combat it. Debating racial prejudice in the classroom is important to break the process of invisibility on this issue, even because, the worst thing in a battle is not knowing where the enemy comes from and what is his true position (SANTOS, 2001).

Figure 7 – Percentage distribution of responses to the question: “Have you ever witnessed a situation in which a black person suffered prejudice due to the color of their skin?” (N=20)



Source: Authors (2023).

Next, we will analyze the answers given to the tenth and last question, open and discursive, which was: “Which topic addressed in this presentation most

aroused your interest? Explain why, please.” The responses indicated that the subject of black women in the exact sciences, in general, aroused great interest among the participants. Below are some of the responses provided by participants to this question: “Black women in mathematics, because it is great to see that a woman is interested in mathematics”; “The first woman to earn a degree in mathematics”; “The achievements and discoveries by women mathematicians who have won several awards”; “About women trying to reduce male chauvinism”; “Learning more about these important women who are not talked about”; “Women in Mathematics: I am passionate about Mathematics and its history”; “About women, for having the strength to help each other.” Thus, some of the reasons mentioned were the importance of seeing black women excelling in mathematics, the appreciation of the conquest and discovery made by these women, the need to reduce male chauvinism, the search for knowledge about important and neglected women by history and the recognition of the role of women in mathematics. These responses reveal the positive impact of addressing, in the educational context, the presence and contributions of black women in the exact sciences, as this arouses the interest of students and promotes reflection on equal opportunities and the appreciation of diversity in the scientific field. These data point to the relevance of debating, in a broader way, in the classroom, on the contribution of women and the black diaspora to scientific development (SOUZA *et al.*, 2019).

Conclusions

Throughout this article, we explore the importance of black women in mathematics, highlighting their contributions and examining the challenges they have historically faced. Our analysis revealed the need to address the issue of intersectionality when discussing black women's participation in this field, recognizing that their experiences are shaped by the intersection of different forms of identity. Black women face a multitude of oppressions and challenges, not only because of their gender, but also because of their race and social class: their

experiences are unique and cannot be understood in isolation from the complex and interconnected realities in which they live.

In considering the importance of intersectionality in mathematics, it is essential to question and challenge the stereotypes, prejudices and barriers that have perpetuated the exclusion of black women from this field. Negligence regarding the history of black women and the scarce bibliography that still exists on this subject imply the need to expand existing research in this regard.

Mathematics is enriched by the diversity of perspectives and experiences: therefore, neglecting the participation of black women prevents a full and comprehensive advancement of mathematical knowledge. Thus, the inclusion of black women in mathematics is not only a matter of social justice, but also of intellectual enrichment and scientific progress. Their contributions are key to a broader and more accurate understanding of the discipline, as they bring unique perspectives and innovative approaches to problem solving and theory development.

It is critical that academic institutions in the field of mathematics adopt concrete measures to promote the inclusion of black women by ensuring equal access to mathematics education, career opportunities, and representation in leadership positions. In addition, it is necessary to promote a welcoming and inclusive environment, free of prejudice and discrimination, in which black women feel valued, respected and empowered, so that they can contribute fully to mathematics. However, it is worth noting, of course, that it is vital that the presence of more black women in mathematics is not just a concession, but a commitment to redefine the practices of this field.

Thus, it is vitally important to deepen research on intersectionality in mathematics and on the achievements of black women in this field, which can collaborate to promote equal opportunities and create inclusive environments. Recognition of the work done by black female mathematicians in the past is an important factor in building a more diverse future in the field of mathematics, in which people from diverse backgrounds have the opportunity to participate and thrive.

To ensure the inclusion and retention of young black women in higher education, especially in STEM fields, a comprehensive set of public policies is crucial. Affirmative action initiatives, such as racial and social quotas, can be implemented to provide equitable access to university spaces. Financial barriers can be addressed through specialized scholarship programs and financial aid, offering targeted support for young black women pursuing higher education. Additionally, psychosocial support services and mentorship programs play a vital role in fostering academic development, helping these students navigate the challenges they may face.

Institutional policies combating racism and sexism within universities are essential for creating inclusive environments. Programs encouraging academic careers, access to educational resources, and flexibility in academic schedules can contribute to a more supportive and accommodating educational experience. By implementing public policies with this profile, societies can work towards breaking down systemic barriers and creating a more inclusive and equitable environment for women of color in STEM education and careers.

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