STATISTICS EDUCATION IN A CRITICAL PERSPECTIVE FOR THE STUDY OF INTERSECTIONALITIES

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ABSTRACT

This study examines, with focus on statistical education, how intersectionality appears in didactic tasks for Brazilian school education, developed by IBGEeduca, an educational platform organized by IBGE (Brazilian Institute of Geography and Statistics). In this study, intersectionality was used as an analytical tool to help understand and explain the complexities of the world that impose social injustices through interrelationships of power categories. The documentary methodological approach adopted in this research is part of a doctoral research project. The criteria for choosing the analyzed tasks were based on the authors' perception of the intersectional categories in the examined pedagogical proposals. We present an interpretative analysis of an IBGEeduca proposal from the theoretical perspective of critical statistics education. This investigation revealed several themes related to contemporary problems present sporadically in the proposed activities, requiring greater scrutiny of the hidden intersections among the categories exposed in the proposals. The findings of this Brazilian case study could spark conversations about how statistics teachers can use tasks to help students understand concepts of inequity and social injustice.

Keywords: *Social justice; Critical Education; Intersectionality; Equity*

1. INTRODUCTION

Critical education, or critical pedagogy, aims to make connections between educational practices and the actions that are needed for social transformations to combat inequalities, oppression, and social injustices (Freire, 2013). Statistics and mathematics skills can be tools for interpreting such situations from a critical perspective, requiring us to look at the most varied fields of learning (Weiland, 2017). One of the main objectives of education, especially statistical education, is to educate people on the vulnerabilities, violence, discrimination, and the complexity of situations experienced by people or groups using data. Engel et al. (2021) in their studies on civic statistics suggest that it is imperative that citizens have a critical understanding of quantitative indicators linked to social problems.

The statistics education perspective is common to studies on intersectionality, which initially departed from feminist research and aimed to understand how the articulation of different social categories (class, genders, race/ethnicity, sexuality, among others) interconnect, structure lives, and produce/reproduce injustices (Collins & Bilge, 2021). Recently, intersectionality has been used as an analytical tool to investigate the coexistence of distinct factors, also called axes of subordination, which occur simultaneously in people's lives.

Given the potential of intersectionality and statistical education studies to educate critical citizenships, we raise the following question: how can the tasks in the pedagogical proposals present on the IBGEeduca website help school students understand social inequalities through intersectionality? We study and report on how intersectionality is presented in the proposals for teaching activities

developed by IBGEeduca with a focus on statistical education and geared toward elementary school (10-15 years old).

This study employs a qualitative documentary approach and is based on content analysis (Kripka et al., 2015). The criterion for choosing the activities analyzed was our perception of the intersectional categories present in the titles of the pedagogical proposals on the IBGEeduca portal. We conclude that statistical data are rarely explored, suggesting that intersectional studies on the categories of power that cause social injustice, inequality, oppression, and other factors, can improve course materials. This case study was conducted in the Brazilian context and has the potential to generate discussions and insights for anyone who produces or proposes to produce didactic materials with a focus on statistical education, equity, and social justice.

2. INTERSECTIONALITY: AN ANALYTICAL TOOL FOR SOCIAL PROBLEMS

The term intersectionality has been adopted in several different areas of society. University students and teachers, human rights activists, public service representatives, social movement leaders, elementary school teachers, social workers, and other social groups, have begun to use the ideas of intersectionality in recent years to transform or, better, understand certain phenomena and social problems that cause inequalities. Such groups discuss issues related to public policies, racial cultural diversity, feminism, gender issues, working class rights, initiatives to combat violence, among other related subjects. These groups use this term to declare and claim their rights in political and intellectual domains (Collins & Bilge, 2021). However, though it is present in the discourse of so many social issues, the term "intersectionality" is typically not clearly understood by the people who adopt it.

Our research uses the conceptualization defined by authors Collins and Bilge (2021), who describe intersectionality as an area that investigates power relations that influence social relations marked by diversity, as well as people's individual and everyday experiences. They also highlight that the six central ideas of intersectionality are social inequality, power relations, social context, regionalism, social justice, and complexity. This definition helps us understand that the power relations present in society are related and shaped by each other, and are not exclusive or present in different entities. Power relations "overlap and function in a unified way" (Collins & Bilge, 2021, p. 16); they modify and articulate themselves in different social contexts and can imply different social phenomena. Similarly, Crenshaw (2002) explains that intersectional analysis should consider the interactions between social markers of gender and race, using them to diagnose the reality of those interactions and their recurring inequalities as well as to devise methods for acting on them.

Additionally, Collins and Bilge (2021) explain that intersectionality can be adopted as an analytical tool for the study of social injustices or inequalities when considering the interrelationships of power categories such as race, class, gender, sexual orientation, nationality, regionalism, work capacity, ethnicity, and age group. Intersectionality as an analytical tool allows people to better understand social problems, their contexts, those of others and those close to them. Each social movement determines a category of analysis focused on a specific category of action. Examples of these investigations can include: race in the civil rights movement; gender in the feminist movement; working class in the union movement (Collins & Bilge, 2021). In this study, intersectionality becomes a means of critically analyzing and understanding power relations present in the proposals for pedagogical activities suggested by IBGEeduca.

A recent example illustrating intersectionality as an analytical tool on a global level involves the xenophobic attacks that occurred during the 2022 presidential election period in Brazil, as highlighted in a G1 periodical. G1 (Globo, 2023) is a widely recognized news website published by Rede Globo that has a large audience in Brazil. Part of the population in the North and Northeast regions of the country suffered hostility from voters from the South, Southeast, and Central-West regions. The provocations and attacks were motivated by the voting opinion of voters from less favored regions in relation to the candidate for president of the republic of Brazil. The objective of the attacks was to diminish and discredit voters' capacity for critical social and political reflection. In a disrespectful, pejorative, and highly offensive manner, voters from the South, Southeast and Central-West regions ridiculed the culture, history, economy, and geographic territory of voters in other regions. In this example, we can use intersectionality to study regionalism in favor of civil rights, or even analyze how it can influence professional opportunities and the marginalization of a group in the country.

Furthermore, the predominant racial demographics of each region could be contrasted. Recently, numerous similar examples have emerged where race and ethnicity are intertwined with power dynamics in Western countries. This negative pattern of political interaction in the Brazilian context, increasingly prevalent in many nations, is evident in the rise of both right-wing and left-wing extremist parties, exacerbated by political polarization amplified through social networks.

Collins and Bilge (2021) highlight another example also present in the Brazilian social context in which intersectionality can be used as an analytical tool to understand gender inequality. The authors highlight the power relations present in the FIFA World Cup football championship. Intersectionality in this example shows how power relations of race, gender, class, nation and sexuality influence decision-making in sports. The intersectional relationships present in "differences in wealth, national origin, race, gender and ability shape patterns of opportunities and disadvantages in sport[s]" (Collins & Bilge, 2021, p. 20). The manner in which these relationships intersect determines the advantages and difficulties that each player will face. Their life experiences, cultural background, region of birth, social class, and economic class are intersectional structures that directly influence the opportunities offered to each person. The few romanticized success stories overshadow the many cases of poor and peripheral young people who fall into oblivion without achieving the expected success. The salary difference between men and women who practice the same sport and achieve similar achievements can also be compared.

Unfortunately, social inequality and, consequently, economic inequality are global problems that can be perceived as an intersectional structure allowing us to study the lack of equity in power relations. We can see this in the labor market when racial and gender differences, for example, influence hiring practices, job security, retirement, health benefits, and salary ranges. "These aspects do not affect different social groups in the same way"- people of color, young women, residents of rural areas, undocumented people, and people with different skills face barriers in accessing safe, well-paid jobs with benefits" (Collins & Bilge, 2021, p. 33).

Given this scenario, intersectionality compels us to reflect on wealth inequality in our society. Collins and Bilge (2021) explain that examining data on the family, and not on individuals, allows us to better measure economic inequality among different social groups. Explanations need to go beyond class by examining other social groups. Collins and Bilge (2021, p. 35) state that: "Intersectional structures that go beyond the category of class reveal how race, gender, sexuality, age, ability, citizenship, relate in complex and entangled ways to produce economic inequality." The Black Women's Movement in Brazil, in 1975, is an effective illustration of the use of such an approach (Collins & Bilge, 2021). To jointly study wealth disparity and social group differences, intersectional frameworks have been employed by Black women in the struggle for recognition of their race-specific needs.

The movement began with the Manifesto of Black Women at the Brazilian Women's Congress promoted by the United Nations (UN), which proposed the recognition of the specific needs of Afro-Brazilian women. The ideals of the Black Women's Movement converged in some points with Brazilian feminism and in others with the Black movement. These isolated movements addressed relevant issues related to feminism and anti-racism, but "neither Brazilian feminism, led by women who were mainly rich and white, nor the black movement, actively engaged in the demand for a collective black identity [...]", would be able to faithfully meet the specific needs of Afro-Brazilians (Collins & Bilge, 2021, p. 33). The creation of the Black Women's Movement reveals how the intersectionality of different power relations influences the analysis of each social group's needs. Even though they were women, they did not feel fully welcomed by the feminist movement; even though they were Black, they did not feel fully embraced by the ideals of the Black movement.

The intersectional structures of Black women are marked by common experiences that are often entangled in experiences of domination, exploitation, and marginalization. For example, African American women were more vulnerable to violence, especially those that lived in poor communities and did domestic work (Collins & Bilge, 2021). The examples discussed show that, in addition to being an analytical tool, intersectionality can be seen as a means of investigating critical theory, of studying the characteristic intersections and specific needs of a given category. In this sense, statistics is the tool which provide numbers to identify the social inequities faced by groups, and statistics education, from a critical perspective, converges with the precepts of intersectionality. Both seek to understand social phenomena critically. Therefore, in the next section we will discuss the main ideas of statistics

education from a critical perspective, which, associated with studies on intersectionality, served as theoretical support for our analysis of the pedagogical tasks proposed by IBGEeduca. In this case study-based research, we explored the depth to which statistics educational approaches delve into complex social issues, primarily focusing on an intersectional analysis of the tasks.

2.1. STATISTICS EDUCATION FROM A CRITICAL PERSPECTIVE: A METHODOLOGICAL TOOL FOR UNDERSTANDING SOCIAL PROBLEMS AND INTERSECTIONALITIES

Statistics education, from the perspective of critical education, has the potential to help students analyze the causes that impose on them or others social injustices. Firstly, we take the term criticism as the art and ability criticize and make a critical judgment on situations experienced. This idea is illustrated by the theoretical framework developed by Weiland (2017). The author positions critical statistics education as one that enables citizens to read the world and allows them to uncover the hidden structures and discourses present in society.

In this way, being able to understand the organization of society through a critical education and statistics lens, citizens will have the opportunity to have a new vision of the world. One important facet of critical education is to link pedagogical acts to the social reality of students, so that they seek to actively and critically participate in confronting situations that cause inequalities, oppression, and social injustices. According to Freire (2014), when human beings begin to understand the social context in which they are inserted and can raise hypotheses about their challenges and their viable solutions, they will be able to transform their reality, rebuilding the world in their own way. Naturally it follows that an education contrary to this is one in which the student's agency is considered makes such a transformation impossible. Freire (2014, p. 40) further suggests that “adapting is accommodating, not transforming.” Education must provide opportunities for students to develop their potential and their ideas about, for example, problems of social inequality. One approach would be to apply education, mathematics, and statistics from a critical perspective.

As a result of adopting this critical perspective, mathematics education and, consequently, statistics education have undergone several transformations over the years. At the turn of the 20th century, the teaching and learning of mathematics were marked by a non-creative style, in which students were taught to apply concepts, rules and formulas, of which was also applied to the teaching of statistics. Skovsmose (2015) is critical of that approach, suggesting that if students are to truly learn something, they need to take initiative, generate plans, and act upon what has been learned. To bring about a change the teaching and learning of mathematics, several researchers worked hard using Paulo Friere’s studies to develop a new teaching approach, an approach focused on the empowerment of marginalized classes. This movement gave rise to the first studies in critical mathematics education (CME).

According to Borba and Skovsmose (2006), Marilyn Frankenstein, Arthur Powell, Paulus Gerdes, John Volmink, Munir Fasheh, Ubiratan D'Ambrosio, Ole Skovsmose and Stieg Mellin-Olsen were the first to undertake studies on mathematics education from a critical and political perspective. Skovsmose's (2007) was very serious when discussing his concerns with the development of CME theory, specifically racism, sexism, and elitism. Therefore, he proposed that critical mathematics education favor a connection between mathematics education and the strengthening of democracy. Skovsmose (2006) recommends developing mathematical education that supports citizenship and democracy, having as its central pillar reflection on the political and social roles that mathematics and mathematical education play in society.

For Geiger et al. (2023), mathematical and statistical education for citizenry is outlined as the need to develop quantitative skills among citizens so that they can participate in society in an informed, critical, and responsible way. The connection between statistics education and citizenship aims to equip individuals with the skills needed to understand and address more complex social, economic, and cultural issues. This perspective aims to reduce or end alienation and, thus, provide the emancipation of the being; this can be achieved through statistics education from a critical perspective.

Weiland's study (2017), based on the theoretical contributions of Paulo Freire in critical education and Ole Skovsmose in critical mathematics education, focuses on understanding the role of teaching statistics using an empowerment approach. Statistics education is an interdisciplinary science, as it is involved in a variety of activities, ranging from simple tasks, such as the assembly of graphs, to issues

of social and political relevance. For Engel et al. (2021), statistics education aims to promote statistical literacy among citizens, enabling them to understand, analyze, and interpret statistical information present in different social, economic, and political contexts. Statistics education is not limited to teaching statistical formulas and techniques, but also emphasizes the development of critical thinking, the ability to question data, identify biases, and make informed decisions based on statistical evidence. For the authors, it seeks to enable individuals to actively participate in society so that they can contribute to a more informed, participatory, and democratic society.

Through statistics education, students are encouraged to explore complex social and economic issues and use statistical tools to make decisions based on evidence. Furthermore, statistics education involves the development of a critical stance in relation to information, encouraging students to evaluate the provenance, quality, and credibility of presented and collected data. Also, according to the authors, it is extremely important to integrate statistics education into different disciplines, promoting an interdisciplinary approach that allows students to apply statistical concepts to the real world.

The statistics teacher, as conceived by Souza et al., (2020), has the power to promote the development of students' identities when teaching. This is done by understanding the social problems around them and actively participating in the situations that cause and/or impose such problems. This active approach to teaching statistics allows students to have a politicized position and be able to act in situations of inequality in the future. The critical perspective aspires to go beyond the simple transmission of knowledge to position actors in the educational environment, so that they understand the mechanisms of oppressive social scenarios and injustices. It is, therefore, imperative to provide training for students that generates concerns, doubts and uncertainties. In other words, have training that helps students question all of the information that reaches their eyes and ears, and, in this way, they are able to position themselves. Ultimately, it is necessary to prepare students to act critically, by questioning the power relations imposed on society.

Weiland (2017) highlights that he does not perceive opportunities to discuss sociopolitical issues with students. He fears that if they do not do it in school, how can they be expected to after they finish? Using the theoretical framework he proposes, Weiland highlights that statistical investigations can not only mitigate and shape sociopolitical issues that cause and impose injustices, they can also be used to build arguments capable of remodeling power structures to achieve a more just society. Similarly, Hollas and Bernardi (2018) suggest that students must realize, through critical statistics education, that investigation goes beyond knowing how to apply formulas and memorize concepts, as has been happening for years and years in education. On the other hand, the teaching and learning process must form the student as an independent, enthusiastic and researcher subject, capable of developing their hypotheses, constructing arguments, expressing opinions and conclusions.

The true purpose of critical statistics thinking is to allow citizens to critically analyze and relate the data presented to them and ultimately use that data to be make decisions in a critical and political manner. Statistics education employing a critical perspective goes beyond understanding the meaning of data, it makes it possible to question the power structures present in society. This involves asking questions about who collects the data and who reports the statistics, who benefits or is harmed by the interpretation of the data or by the social structure itself exposed by the numbers. Instead of just accepting statistics as an objective representation of reality, statistics education conveyed from a critical teaching perspective will help students to understand systemic influences that can perpetuate injustices.

Thus far, we have discussed the relevance and primary goals of statistics education from a critical perspective, as the objective was to study how intersectionality is presented in the proposals for elementary teaching activities prepared by IBGEeduca. We chose IBEeduca as IBGE is Brazil's primary governmental statistical agency, responsible for collecting, producing, and publishing diverse data and information across various social fields. As the foremost statistical authority in Brazil, IBGE's missions are aligned with several themes related to contemporary issues present in the proposed activities, albeit in a fragmented manner. The tasks recommended for students by IBGEeduca often focus on limited factors that contribute to inequalities, necessitating a closer examination of the hidden intersections within these categories.

Our analysis suggests that posing critical questions may inform the design of tasks that enable students to grasp concepts of inequity and social injustice. Understanding inequalities to foster ethical relationships, democracy, and social justice is an educational imperative that transcends the Brazilian context.

In the following section, we will describe the step-by-step process that led us to achieve the objective proposed in this investigation.

3. METHODOLOGY

To methodologically achieve the objective of this research, we employed the documentary research methodological framework. The objective of documentary research is to collect, analyze, and interpret information contained in written documents, such as books, articles, reports, historical records, laws, regulations, among others. Therefore, we analyzed how intersectionality is present in the proposals for elementary school level (10-15 years old) teaching activities developed by IBGEeduca with a focus on statistics education. Although the tasks analyzed were created within the Brazilian sociocultural context, understanding power relations with an intersectional and statistical analytical perspective in order to combat unjust structures is necessary in all democratic societies. The social injustices and inequities that are present in Brazilian society and many others are central themes in this study.

We consider that the activities analyzed enable students to learn specific concepts in statistics, mathematics, geography, history, and other fields. If well statistically explored, the activities can provide insights for people from different regions and nationalities who wish to analyze real data from society and map the social problems of their own context.

Documentary research, according to Silva and Mendes (2013) is a robust method capable of making important insights in investigations. Kripka et al., (2015) states that documentary research employs methods and techniques that are used for the assimilation, perception, and study of diverse types of documents. We use Cellard's (2012) conception of "document" in that "document" refers to everything that can testify to something. These "documents" can be written texts, but also can be of an iconographic and cinematographic nature as well as any another type of recorded testimony, everyday objects, and elements of folklore. Therefore, the documents we used to develop this investigation were the pedagogical activities aimed at elementary education (10 – 15 years of age) proposed on the IBGEeduca portal, as previously mentioned. We chose this level of education in order to later expand this study to introducing redesigned tasks into schools beginning with the authors' own classrooms.

Our selection criterion was that the activities contained one or more power relations in its title. This data was tabulated and later interpreted. To analyze the content of these proposals, we used the content analysis method which, according to Kripka et al. (2015), aims to explain and systematize the content of the message and the meaning of that content through logical and justified deductions, taking as reference its origin (who sent it) and the context of the messages or the effects of this message.

To this end, the analysis was developed in three stages: (a) pre-analysis which consisted of surveying activities that involved power relations in titles; (b) exploration of the material, which consisted of a more in-depth analysis of the content of the proposals, analyzing the competencies, objectives and procedures oriented in the tasks; and finally (c) the treatment of results (Bardin, 1979), we sought, based on the analysis of the content of the tasks, to discuss and emphasize the possibility of articulated work between statistics education and intersectionality in a critical perspective of education. In next section, we will present and discuss the results obtained from the categories found, always establishing the grouping of thoughts and/or expressions around the intersectionality of powers.

4. ANALYSIS AND RESULTS

IBGEeduca (2023a) is an IBGE portal focused on education where playful and illustrated pedagogical proposals can be found, based on updated data on social issues in Brazil. In addition to activities, the portal provides resources that can be used in the classroom, such as videos, maps, graphs, games, and explanatory materials. The portal has three tabs: "children," which includes games and maps to discover Brazil; "young people," which covers information about the country and the population; and "teachers," which are available activities and resources to the classroom. We analyzed the tab aimed at teachers. Activities intended for the classroom are divided into categories: early childhood education, elementary education (initial years - 5 to 9 years old and final years - 10 to 15 years old), secondary education, youth and adult education, technical education and higher education, of which the latter two contained no activities. The curricular components of these categories are geography, mathematics and interdisciplinary.

For this paper we analyze activities related to elementary education (10 to 15 years old). The first two authors, besides being researchers, are teachers of this stage of education and will soon use this material at school. The activities deal with different themes and problems, based on real data from Brazil—which may be similar in many developing countries—and have the following structure: competencies in common agreement with the National Common Curricular Base (Brasil, 2018) that can be developed; objectives; contents; resources; and execution steps. Table 1 illustrates a quantitative survey of elementary school tasks that raise discussions about power relations. To analyze the tasks, we related their titles to some of the categories discussed by Collins and Bilge (2021), namely: class, race, gender, ethnicity, regionalism, and age group.

Table 1. Quantity of IBGEeduca activities that present power relations in their title

Power relations	Class	Race	Gender	Ethnicity	Regionalism	Age group
Class	1	0	0	0	1	0
Race	0	1	0	0	0	0
Gender	1	0	2	0	1	0
Ethnicity	0	0	0	0	0	0
Regionalism	0	0	0	2	4	0
Age group	0	0	0	0	0	4

We analyzed 35 proposals, excluding those for which we were unable to identify power relations in the title. In Table 1 we show that among the 35 IBGEeduca activity proposals aimed at elementary education, only 17 of them directly presented in the title one or more power relations discussed by Collins and Bilge (2021). The sum of the numbers shown in the table indicates the number of proposals analyzed, that is, 17 proposals. The captions observed in the rows and columns of the table indicate the category of power evident in the title of each proposal. For example, the number one in the upper left corner of the table indicates that one of the tasks proposes the study of only one category of power, that is, social class. The number four, positioned in the lower right corner of the table, indicates that four of the proposals suggest studying only the age category. Although racism is a structural problem in Brazil, of all the proposals, only one of them had the category race in its title. The relationships between age group and regionalism are themes present in most of the proposals. Less than 50% of the proposals contained power relations in the title and those that did listed a maximum of two categories of power. Among the 17 activity proposals, 12 did not present intersections between two or more power relations. We determined that:

- One activity presents in its title only a social class category, entitled Commuting to Work or Study;
- One activity presents in its title only race category, entitled Knowing some information about color or race;
- Two activities present only gender category, entitled Women and Education; and Constructing graphs - Distribution by sex;
- Four activities present only regionalism category, entitled The extreme points of Brazil; Urban population and rural population; The population of your municipality; and Land cover and use in Brazil;
- Four activities present only age group category, entitled “Violence against adolescents”; “Adolescent health: getting to know PeNSE (National School Health Survey)”; “Age pyramid”; and “Child Labor in Brazil.”

As for the activities that present an intersection with two or more categories of power relations in the title, Table 1 indicates five proposals:

- One activity presents in its title the intersection between categories of class and regionality, entitled “Studying agricultural production in Brazil”;

- One activity presents in its title the intersection between categories of gender and regionality, entitled “Analyzing and Contextualizing Social Indicators of Women in Brazil”;
- One activity presents in its title the intersection between categories of gender and social class, entitled “Women: education and work”;
- Two activities present in its title the intersection between categories of ethnicity and regionalism, entitled “The regions and countries of the African continent”; and “Places with Indigenous Names.”

In terms of quantity, we recognize that the Brazilian Institute of Geography and Statistics (IBGE) seeks to include social data related to issues directly influencing the inequalities and social injustices present in Brazilian society. Even if in small amounts, the proposals do display the intersection of different power relations. However, when analyzing the content of the activities, we realize that they all primarily aim to support the understanding of techniques related to basic statistics. We understand the importance of making students understand such statistical concepts, but as Weiland (2017), Hollas and Bernardi (2018) and Engel et al. (2021) suggest, statistics education goes far beyond memorizing definitions or interpreting information. It is imperative that students are placed in situations that encourage them to develop critical thinking, the ability to question data, identify biases, and make decisions based on statistical evidence. The statistical data in the proposals has the potential to lead students to critically question their participation and representation in society. However, the institute emphasizes that most proposals are aimed only at supporting the understanding of the statistical concepts contained in them so that students can do things such as interpreting or constructing of tables and calculating frequencies and percentages. The complex social problems hidden behind intersecting classes of power could be brought to light through the lens of statistics.

We carried out a more detailed analysis of the activity women and education, which is a representative task within all the activities (IBGEeduca, 2023b). The proposal's main objective follows the goals of the Brazilian Common Curricular Document (BNCC). The proposal therefore is aimed at developing the interpretation and resolution of situations involving research data on environmental contexts, sustainability, traffic, responsible consumption, and others. It also aims to have students present said results in tables and different types of graphs as well as writing reports to synthesize their conclusions. It is second main objective is to develop in students the ability to analyze and identify, in graphics published by the media, the elements that can lead—sometimes on purpose—to reading errors, such as inadequate scales, unexplained or incorrectly captions, omission of important information (sources and dates), and others (Brasil, 2018). The activity includes a study developed by IBGE that deals with gender statistics social indicators of women in Brazil. It proposes three stages in its methodological procedures: (a) present the graphs to students; (b) talk to students about the structure of the graphs, highlighting the title, the titles of the horizontal bars, the captions, and the sources; and finally (c) organize them into groups of up to three members so that they can write a collaborative dissertation text about women in education, based on the information in the graphics (Figures 1 and 2).

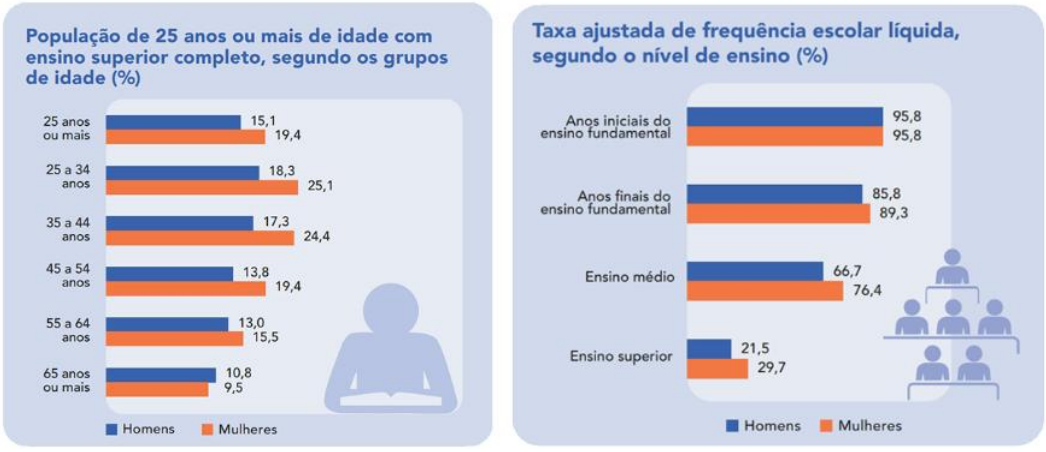

Figure 1. Activity proposal for elementary school final years. Source IBGEeduca

The left graph shows population of 25 years old or more that finish its undergraduate course (men are indicated in blue and women in orange).

The right graph shows tax of frequency by scholarly level of study. The top refers to elementary school, the bottom to university level (men are blue and women are orange).

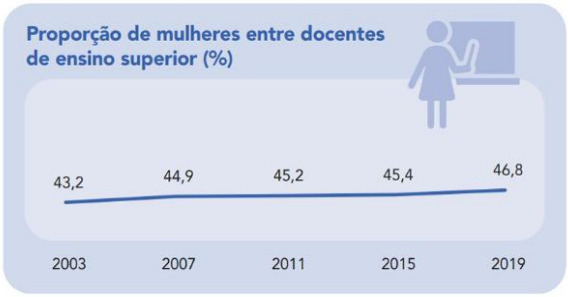

Figure 2. Activity proposal for elementary school. Source IBGEeduca

The graph above shows proportion of women working as lecturers at the university level.

When analyzing the proposal, we realized the possibility for teachers to expand and deepen students' understanding of the complexity of the problem. The activity allows for the study of the intersectionality that exists between the power relations of gender, race, class, age group, and regionality. Using Collins and Bilge's framework (2021), intersectionality in this study is used an analytical tool for examining social problems in Brazil. We understand that statistics can be used as a quantitative social analytical tool with the potential to help people understand issues that permeate civic life, social inequality, and racism (Engel et al. 2021). We suggest discussing with students, for example, the inequality in study completion rates among women of different races and in different regions of the country. Alternatively, we recommend adding more data to the proposal to analyze whether race and related regionalism influence the women's studies rates and educational levels.

In this specific proposal, the statistical data presented in the graphs did not allow us to understand the four power relations (gender, race, regionalism, and age group) related to the social problem initially presented, i.e., education of women in Brazil. Intersectionality in this case therefore can be used as an analytical tool to study the particularities of groups of women. It is possible to encourage students to critically reflect on how these categories establish power relations and end up influencing the professional valorization of women in the job market. Additionally, the proposal can encourage the study of the ease and difficulties women face in completing their studies depending on their age, race, and regionalism.

From the critical perspective of statistics education, the processing of statistical data, the reading of pictorial graphs and the interpreting of numbers in a broader perspective are essential for teaching and learning statistics, as well as for leveraging criticality in complex social contexts (Weiland, 2017). It is also necessary to develop in students a critical understanding of such data for making decisions in real life. Therefore, provocations that lead students to reflect and question their reality can be encouraged through the analysis of real statistical data made available by the IBGE itself or other government databases.

The data presented in the initial proposal allows teachers to raise questions, i.e., to instigate students, so that, based on statistical knowledge, they can have a critical understanding of the situations presented. Teachers, for example, can ask the following questions:

- Which gender has the highest rate of completion of studies in higher education?
- Why do women represent a higher percentage of this population?
- What can be done so that women have a greater presence in higher education?

The problematization of such data not only challenges students, but also broadens their perspective to other issues beyond the activity. Intersectional questions can also be offered such as:

- What is the rate of black women who have a higher level of education?
- What can be reflected in this index?

- And if we compare the rate of white women with higher education levels to that of black women, what can we see?
- In which age group do black women have the highest rate of training in higher and basic education?
- What are the possible reasons that justify the data presented?
- Which region of the country has the highest rate of black women with completed higher education?
- Comparing indices between regions, what can we conclude from this?
- Based on statistical data, what is the profile of women who completed higher education? Is it fair? Is there room for change in this scenario?
- Do you have political suggestions?

Additional data collected from the IBGE website can also enable us to statistically address these challenges (Tables 2 and 3; Figure 3).

Table 2. Women's study completion rate by educational stages by color or race and level of education.

Level of study completed	White people	Black people
Elementary School	1,821,000 (94.8%)	2,966,000 (88.1%)
Secondary School	1,855,000 (82.3%)	2,764,000 (70.3%)
University	1,906,000 (37.4%)	2,664,000 (17%)

Note. Source IBGE. Continuous National Household Sample Survey, 2nd quarter, 2019. Adapted table.

Table 3. Study completion rate in Elementary School II by color or race and regionality.

Region and race	White people	Black people
North	88,000 (90.5%)	414,000 (82.6%)
Northeast	329,000 (90.3%)	1,113,000 (84.9%)
Southeast	859,000 (97.1%)	1,014,000 (93.0%)
South	439,000 (94.4%)	181,000(90.3%)
Central west	106,000 (94.7%)	244,000 (90.8%)

Note. Source IBGE. Continuous National Household Sample Survey, 2nd quarter, 2019. Adapted table.

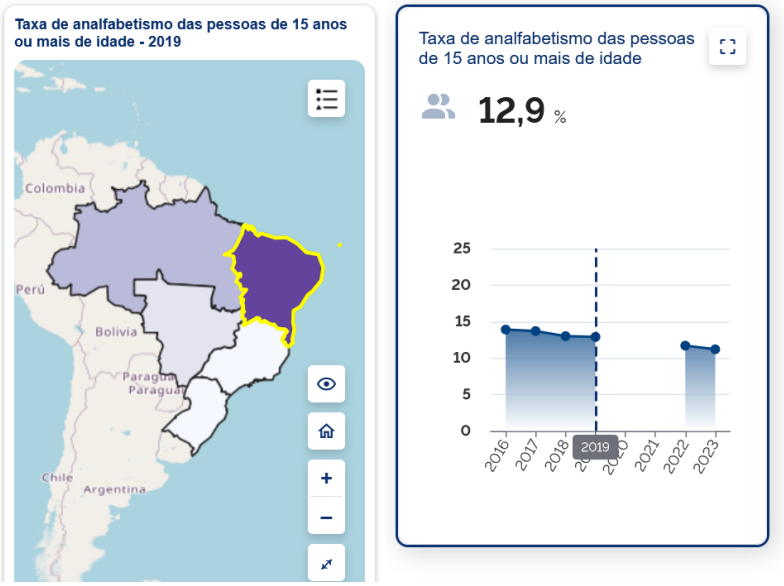

Figure 3. Illiteracy rate in 2019 for people aged 15 and over (https://painel.ibge.gov.br/pnadc/)

Tables 2 and 3 present data collected by surveys carried out by IBGE in 2019 and 2021. The data contains social indicators of gender statistics for women in Brazil. In Table 2 we highlight the study completion rate of women by education and skin color or race. From these data we realize that the highest rate of black women in relation to white women, who completed their studies, is in elementary education, with this rate decreasing significantly in higher education. This observation can be highlighted in the classroom to provoke critical reflection in students, leading them to question the reason for this difference. Another aspect worth analyzing with students is the illiteracy rate among individuals aged 15 and older across different regions. Students observing the data (Figure 3) will note that the highest illiteracy rates are concentrated in the North and Northeast regions (darker color in figure). Delving deeper into the data (Table 3), they will find that these regions have a predominantly Black population, unlike other regions. This intersection of gender, race, and regionalism highlights power relations.

Further analysis of Table 3 reveals that the highest rates of women completing elementary school are in the South, Southeast, and Central-West regions of Brazil. Among these regions, White women have higher completion rates compared to Black women. This scenario underscores how intersecting categories of gender, race, and regionalism serve as analytical tools for understanding social indicators and the complexities of intersectional relationships.

Taking gender, race, and regionalism as intersectional categories discussed in Tables 2 and 3, we can also connect this data with Table 4, which examines the employment rates of women aged 14 and older in informal occupations by race and region in Brazil.

Table 4. Occupation of women aged 14 or over in informal occupations, by color or race and region.

Region and race	White	Black
North	49,6 %	58,4%
Northeast	50,0 %	52,2%
Southeast	30,8 %	38,6%
South	26,8 %	28,4%
Central west	35,6 %	42,3%

Note. IBGE. Continuous National Household Sample Survey, 2021 (accumulated from fifth visits). Adapted table.

Based on the data presented in Table 4, we could discuss with students that the regions with the highest female employment rates in informal jobs are the North and Northeast and that, when compared with the rates in these regions, the rate for black women stands out as the highest among them. We could also compare salaries in these regions. In addition to these amendments, we also recommend expanding the skills that the initial study proposal intended to improve. The amended activities can help develop students' ability to plan and execute a sample survey, involving a social topic, so that they learn to communicate the results through a report that contains the evaluation of central tendency and amplitude measures and appropriate tables and graphs, constructed with the support of electronic spreadsheets. Teachers can encourage students to collect data that deal with the theme "Women and Education" in the context of their community or regionalism, for example, based on data already available at IBGE.

To summarize, using studies on intersectionality together with statistics, as social analytical tools, has the potential to contribute to the development of a critical perspective in students. Pedagogical proposals can stimulate studies of intersectionality based on the graphical analysis of social injustices and inequalities. Thus, students will be able to empower themselves in the face of reality and understand that social phenomena that impose or reproduce inequality or social injustices occur at the intersection of different power relations in society (Collins & Bilge, 2021). If students understand that inequalities affect people differently based on gender, race, and regional groups, they will be better prepared in the future to develop and advocate for policies aimed at addressing critical issues.

Analysis of the proposals highlights a simplification of content from tasks and complex intersectional combinations. In this sense, since we are dealing with issues of great social relevance, teaching statistics from a critical perspective becomes an essential tool allowing students to analyze a social problem, consider different power relations, question the credibility and representation of data, and devise solutions that can change that reality (Engel & Ridgway, 2023; Weiland, 2017). By combining statistics education and intersectionality, we can encourage students to explore social issues critically, having them consider the different facets of each issue to ultimately encourage critical decision-making.

5. CONCLUSION

The research presented in this paper focuses on analyzing how to combine intersectionality studies and statistics education to critical citizens. To achieve this, we grounded our study in a critical perspective on the teaching of statistics proposed by Weiland (2017), who challenges us to explore various scenarios, such as different social issues and problems in our daily lives, to contextualize students' learning. We view statistics as a tool with the potential to study the social injustices, inequalities, and oppression affecting parts of the population.

In addition to this theoretical perspective, we also examined intersectionality studies, which aim to understand how the interaction of different social categories (such as class, gender, race/ethnicity, and sexuality) interconnects, structures lives, and produces or reproduces injustices (Collins & Bilge, 2021). With both frameworks in mind, we raised the following question: how can the pedagogical proposals presented on the IBGEeduca website help students understand social inequalities through intersectionality?

Through a case study, we investigated and reported on how intersectionality is addressed in the teaching activities developed by IBGEeduca, specifically those aimed at statistics education for elementary school students (ages 10-15). We believe this case study can help statistics teachers encourage students to explore concepts of inequity and social injustice.

Through our analysis, we raised questions to stimulate reflection on how to encourage the study of power relations from a critical perspective of statistics. From the IBGEeduca task example we discussed, we observed that examining one or two data categories is insufficient for understanding complex social problems. We as educators therefore need to guide students toward asking more questions and toward constructing solutions capable of reshaping power structures in order to create a more just society.

Leading a learning process that encourages students to become independent, enthusiastic, and investigative, as well as being capable of developing hypotheses, constructing arguments, and

expressing opinions and conclusions—as recommended by Weiland (2017)—could be further enhanced by motivating students to consider social power dynamics.

This investigation concluded that, though several themes related to contemporary problems are present in the proposed activities, these activities could further deepen studies on the categories of power that cause or impose social injustices, inequality, and oppression on various groups.

Finally, we propose broadening the perspective on such activities such that they highlight the complexity of these problems and ask students to grapple with them. The research described here can trigger a new perspective on the teaching of statistics in Brazil and elsewhere. Training for teachers and students is necessary to expand and strengthen their understanding of identity, power in relationships, and role as citizens in the world.

Statistics understanding is one of the essential components of critical thinking that is fundamental for transformative action in society. This study sought new perspectives, paths, tools, and possibilities to be used in the classroom that enable students to understand and find solutions to complex sociopolitical issues. A paradigm that is established in this study is the need to transform these proposals into teaching practices that create citizens able to collaborate in the construction of a more egalitarian society with less oppression of excluded groups. Putting these proposals into practice will be our next stage of research.

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