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RIPEM

Violence against women: a pedagogical proposal for promoting Critical Statistical Literacy

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Abstract: This article is part of a research that aimed to study a pedagogical proposal developed and carried out with high school students from the theoretical perspective of Critical Statistical Literacy. We sought evidence of the contributions that this theory could bring to the teaching and learning of statistics. The methodological technique used was participant observation, which was based on a news article published on social media about violence against women. Data collection was carried out by using three instruments: video recording of the class; teacher's logbook; and videos created by students as a final task. The analysis shows that the theoretical perspective adopted and the use of real data in statistics classes contributed to the development of critical thinking focused on social issues and statistical literacy. Thus, it became possible to offer conditions for implementing what is partially proposed in the curricular documents guiding Brazilian education.

Keywords: Statistical Investigation. Classroom. Critical Thinking. Information Analysis.

Violencia contra las mujeres: una propuesta pedagógica para promover la Alfabetización Estadística Crítica

Resumen: El texto forma parte de una investigación que tuvo como objetivo estudiar una propuesta pedagógica desarrollada y realizada con estudiantes de secundaria desde la perspectiva teórica de la Alfabetización Estadística Crítica. Se buscaron evidencias de los aportes que esta teoría podría aportar a la enseñanza y el aprendizaje de la estadística. La técnica metodológica utilizada fue la observación participante, la cual se desarrolló a partir de noticias publicadas en redes sociales sobre violencia contra las mujeres. La recolección de datos se realizó mediante tres instrumentos: grabación de video de la clase; cuaderno de bitácora del profesor; y vídeos creados como tarea final por los estudiantes. El análisis indica que la perspectiva teórica adoptada y el uso de datos reales en las clases de estadística contribuyen al desarrollo de la criticidad sobre las cuestiones sociales y la alfabetización estadística. De esta manera, fue posible ofrecer condiciones para implementar lo que parcialmente se propone en los documentos curriculares que guían la educación brasileña..

Palabras clave: Investigación Estadística. Aula. Pensamiento Crítico. Análisis de Información.

Violência contra as mulheres: uma proposta pedagógica para a promoção do Letramento Estatístico Crítico

Resumo: O texto parte de uma pesquisa que teve por objetivo estudar uma proposta pedagógica desenvolvida e realizada com alunos do ensino médio a partir da perspectiva teórica do

Letramento Estatístico Crítico. Buscaram-se evidências das contribuições que essa teoria poderia trazer para o ensino e a aprendizagem de estatística. A técnica metodológica empregada foi a observação participante, que se desenvolveu a partir de uma notícia veiculada em mídia social sobre violência contra a mulher. A coleta dos dados foi realizada a partir de três instrumentos: vídeo gravação da aula; diário de bordo do professor; e vídeos elaborados como tarefa final pelos estudantes. A análise indica que a perspectiva teórica adotada e a utilização nas aulas de estatística de dados reais contribuem para o desenvolvimento da criticidade sobre problemáticas sociais e para o letramento estatístico. Assim, tornou-se possível oferecer condições para efetivação do que está parcialmente proposto nos documentos curriculares norteadores da educação brasileira.

Palavras-chave: Investigação Estatística. Sala de Aula. Pensamento Crítico. Análise de Informação.

1 Introduction

Statistics are more and more present in people's daily lives, and their manifestation is evident in different media. Thus, every day people are exposed to information that encompasses data and variables, which makes interpreting charts and graphs necessary to understand issues that are part of their social lives. Moreover, devising graphs and tables based on data is necessary for communication.

The aforementioned perception is also true in schools because of the documents that guide Brazilian education, such as *Base Nacional Comum Curricular* [BNCC] (Brazil, 2018), which says that in the process of statistics teaching, teachers should encourage students to do research on social themes that are part of their reality. Within this context, about the proposals put forward in BNCC, Souza (2023) emphasizes that even though the document shows signs of the work to be done in statistics teaching from that perspective, there has been criticism about its organization — more specifically about the lack of didactical and pedagogical guidelines that could help teachers perform their work within the theme. The proposal should offer conditions so that students could develop statistical literacy in order to become citizens who have a critical, participative and reflective formation (Santos, Santos Junior & Velasque, 2018).

When reflecting upon said formation, it is necessary to have reflections over the process in a way that students are able to understand the reality around them and build their convictions to take action in future decision-making situations. Therefore, when we aim at statistics teaching from a critical perspective, there is the potential to help students to: develop their identities; work with social contexts and situations; empower them to act politically in society (Souza, Lopes & Fitzallen, 2020). It is vital to provide students with opportunities to develop their skills to act when facing important daily subjects, such as politics and citizenship in order to generate reflection about such issues and possible solutions to the decision-making process.

From that point of view, Weiland (2017) presents a theoretical perspective called critical statistical literacy, which suggests that students should develop, through reading and writing, the ability to reflect on social issues. Furthermore, according to the author, based on statistical data, students will be more prepared to make decisions and face the social injustice and the inequality present in their lives. Although this statistical teaching perspective can make a significant contribution, putting it into practice in schools is not an easy task. The lack of pedagogical and formative resources so that teachers can act based on the theoretical perspective is still a barrier to its implementation.

Based on the aforementioned aspects, this article contains an extract from a master's thesis, written by the first author of this text, supervised by the second author, and defended as

part of Programa de Pós-Graduação em Ensino de Ciências e Matemática at Universidade Federal de Uberlândia, Brazil, that aimed to study how students' critical sense could be improved through pedagogical proposals devised and implemented by the first author of this text in a group of third-year high school students from a public school in the state of São Paulo, Brazil. Based on Weiland's (2017) critical statistical literacy, we aimed to understand, through the construction of empirical data, what contributions the pedagogical proposal could make to foster critical statistical literacy.

We devised two pedagogical proposals, and data collection was based on participant observation. In this text, we will discuss one of the proposals, called Violence Against Women, whose development stemmed from an investigation into information published by a federal government website (Câmara dos Deputados, 2022).

The first section of the text contains a discussion about two theoretical perspectives: statistical literacy and critical statistical literacy. Next, we present the research context, the methodology and the pedagogical proposal that was implemented. Finally, we analyze the results of the study and present a reflection on the progress that was achieved in terms of critical statistical literacy regarding statistics teaching and learning, based on the proposed activities.

2 The Perspective of Critical Statistical Literacy

The theoretical perspective adopted in this study encourages using real situations in school activities — situations that are part of students' daily lives, so that they are able to analyze them based on the data and representations of the contexts into which they are inserted and, thus, reflect on possible ways of acting towards issues that cause social injustice.

To start the discussion on the theme, statistical literacy can be understood as the ability to "understand and critically evaluate statistical results that permeate our daily lives — coupled with the ability to appreciate the contributions that statistical thinking can make in public and private, professional and personal decisions" (Wallman, 1993, p. 1). Weiland (2017, p. 34) adds that one of the main arguments for this type of learning is "for individuals to be literate for their roles as citizens within their Society".

With that in mind, Weiland (2017) proposes a theoretical framework that, as mentioned before, is called critical statistical literacy. The framework is based on assumptions proposed by authors from the field of statistics education (Ben-Zvi & Garfield, 2004; Gal, 2002; Wallman, 1993; Wild, Utts & Horton, 2018), who discussed the use of elements that foreground reading and writing for the comprehension of statistics — with emphasis on critical thinking — in order to highlight the importance of considering sociopolitical contexts within this type of literacy.

According to Weiland (2017), the perspective of critical statistics literacy should contribute to a type of literacy that goes beyond merely reading, writing and understanding words and written representations. From the author's point of view, it is necessary to prepare students to read and write the world through new lenses. Weiland's theoretical framework is also supported by Freire's (1996) and Skovsmose's (2008) works on critical education.

> Reading the world through a critical statistical lens includes identifying and interrogating social structures and discourses that shape and are reinforced by data-based arguments. Statistical arguments are not made from an objective independent reality. They are made by individuals from a multitude of subjectivities. In this sense, statistical arguments can serve to perpetuate discourses. It is important for individuals to read into arguments, to interrogate what discourses are creating them, and to determine whether to accept them, while being aware of their inconsistencies, or to

> reject them, and the social structures they perpetuate. This aspect is tied to writing the world with statistics, which includes using statistical investigations to communicate statistical information and arguments in an effort to destabilize and reshape structures of injustice. Just as statistical investigations and arguments perpetuate certain discourses and structures in society, from a critical perspective they can also be used to point out ruptures and discontinuities in them. (Weiland, 2017, p. 42).

According to the author, there is an unprecedented wealth of public data available to the population in today's society: demographics related to justice, educational, social and other systems, which can be found on database websites, such as Painéis Saúde Brasil[1]; Portal da Transparência[2]; Instituto Brasileiro de Geografia e Estatística[3]; Atlas da Violência[4]; Dollar Street[5]. They are all useful to analyze sociopolitical issues like systemic racism, sexism, classicism and other contexts of inequality. Thus, in his structural framework, Weiland (2017) shows that statistical investigations can be used not only to destabilize phenomena that cause injustice or inequality, but also to produce new compositions and discourses that could solve or modify situations that encompass sociopolitical injustice. According to Weiland, it is necessary to consider social and subjective locations, and the political contexts related to the reading of this literacy so that it is possible to understand how they influence one's interpretation of information when reading, criticizing and assessing arguments that contain statistics.

Table 1 contains a summary of Weiland's (2017) theoretical framework, which he named critical statistical literacy. From this perspective, the author compares the dimensions for reading and writing according to his conception and previous theoretical principles.

Table 1: Critical Statistical Literacy Structure.

	Reading	**Writing**
Statistical Literacy	• Making sense of and criticizing arguments based on statistical and quantitative data found in different contexts. • Evaluating the source of data, and how they were collected and reported.	• Formulating statistical questions. • Collecting or finding relevant data to answer the statistical questions that are proposed. • Analyzing data using proper graphical and numerical methods. • Interpreting the analyzed data by addressing the statistical question(s) being investigated. • Discussing or communicating the meaning of the statistical information.
Critical Literacy	• Understanding systems of symbols. • Identifying and interrogating social structures in the world. • Understanding your social location, subjectivity, political context and having political and sociohistorical knowledge of yourself and of the world.	• Creating and communicating your own meaning through systems of symbols. • Actively influencing and molding the structures in society. • Working to alleviate sociopolitical issues linked to injustice. • Negotiating and navigating actively through dialectic tensions in society. • Communicating your social location, subjectivity and political contexts to other people.

[1] Retrieved from https://svs.aids.gov.br.
[2] Retrieved from https://www.registrocivil.org.br.
[3] Retrieved from https://www.ibge.gov.br.
[4] Retrieved from https://www.ipea.gov.br/atlasviolencia.
[5] Retrieved from https://www.gapminder.org/dollar-street.

Critical Statistical Literacy	• Giving meaning to language and to systems of statistical symbols and criticizing statistical information and data-based arguments found in different contexts to develop awareness of the systemic structures that are at play in society. • Identifying and interrogating the social structures that mold and are reinforced by data-based arguments. • Understanding your social location, subjectivity, political context and having political and sociohistorical knowledge of yourself and understanding how it influences the way you interpret information.	• Using statistical investigations to communicate statistical information and arguments in an effort to destabilize and remodel structures of injustice for a fairer society. •Using statistical investigations to alleviate and solve sociopolitical injustice issues. • Negotiating dialectic social tensions when formulating statistical questions, data collection and analysis methods, and highlighting such tensions in the results of a statistical investigation. • Communicating your social location, subjectivity and political context to other people and how it molds one's construction of meaning of the world when reporting the results of a statistical investigation.

Source: Adapted from Weiland (2017, p. 41)

According to Weiland (2017), writing from a critical perspective of statistical literacy involves understanding and navigating through dialectic tensions existing in society. It happens when formulating statistical questions, collecting data and applying analysis methods so that it is possible to see and reflect on how variables are operationalized and how, depending on the context, they could be used to generate social categories and produce discourses that disadvantage individuals and groups that are already fragile. Thus, we understand that it is important that literacy should be interconnected with reading, writing and critical reflections on how statistics are created and presented.

The study on the development of critical thinking among students throughout the statistical investigation was based on the theory of critical mathematics education devised by Skovsmose (2008). This perspective discusses students' critical and participant engagement so that they become able to exercise their citizenship with reflective and critical competence, with an understanding of the technologies around them and through a reading of the world that mathematics learning could provide them with.

When it comes to considering the implementation of critical statistical literacy in the classroom, Weiland (2017) believes that bringing his perspective to schools could be a potentially powerful approach. As we have previously mentioned in this text, its use should take into consideration social and subjective locations and the political contexts that contribute to reflections on this type of learning. The goal is to allow students to understand their reality and use it to support future decision-making through the development of reading and writing based on statistical contents. According to Weiland, when we look at statistical literacy from a critical perspective, we focus on seeking learning experiences that are meaningful to students, so that they can develop writing and reading skills accompanied by reflections, arguments and decision-making regarding contexts that are part of their daily lives – a type of education that is capable of reinventing itself and opposing sociopolitical positions that cause injustices.

According to Weiland (2017), considering sociopolitical contexts in the school environment is still uncomfortable for educators, students and parents, although approaching said theme has been prescribed in curriculums. The implementation of critical statistical literacy in the classroom could contribute to the creation of pedagogical curricular resources, so that teachers could improve and foster this perspective of literacy.

In our study, we devised and applied the aforementioned pedagogical proposals based on the conception of critical statistical literacy, with a focus on its contributions to the teaching

of statistics. In the next section, we will describe the research context and provide details on how the investigation of one of the proposals was conducted.

3 Methodology and research context

This master's degree research aimed to understand how pedagogical proposals formulated through data that circulated on social media platforms could assist in the development of critical statistical literacy. Here we understand social media as websites on the internet that allow people to create and share information, on which users are, at the same time, information producers and consumers. (Torres, 2009).

The research theme reported in this text arose within the context of the Covid-19 pandemic in 2021, when the first author joined *Programa de Pós-graduação em Ensino de Ciências e Matemática* at *Universidade Federal de Uberlândia as a Master's student* and *Secretaria de Educação do Estado de São Paulo* as a mathematics teacher. This investigation took shape when we noticed the constant presence of statistics in the information that circulated on social media about the pandemic caused by Covid-19 in Brazil and all over the world, and when I volunteered in another study which discussed disinformation and mathematics education.

We adopted participant observation as a guiding methodology, whose goal is to perform exploratory and descriptive studies within the observed contexts, aiming at the generalization of interpretative theories. In a non-intrusive way, researchers are led to share documents and habits manifested by the studied groups and to place themselves in favorable conditions to observe situations, facts and behaviors that would hardly ever occur or that would be repressed or even adulterated in the presence of strangers (Mônico, Alferes, Parreira & Castro, 2017). This technique was employed in the first author's workplace. He taught at a public school in the city of Campinas, São Paulo state, Brazil.

The project was initially crafted and submitted to ethical analysis by *Comitê de Ética em Pesquisas com Seres Humanos*, which supervised this study. The research involved 12 students in the third year of high school who were part of groups taught by the first author. Invitations were offered to students from three third-year groups, and participants volunteered to be part of the research. Ten students had already turned eighteen years old, whereas the other two were still seventeen at that time.

The meetings about the proposals took place in the school's computer laboratory outside of regular class hours. This organization inside the school environment accommodated students' schedules to attend sessions at agreed-upon hours. Moreover, it respected the fact that some of them did not have equipment or internet access at home to participate in meetings remotely.

Firstly, we held a previous meeting with students in order to clarify the terms of participation established in the consent and assent forms. Participants' identities were kept confidential through the adoption of fictitious names. Next, we started the study, which occurred between October 18th and November 8th, 2022, through weekly meetings totaling four sessions.

In this text, we present an analysis of the second proposal, which occurred in our third meeting with the students. Each session lasted three hours, with two hours allocated to investigate the presented data and one hour dedicated to collective discussion and interaction. Our decision to engage the students in the investigation of the pedagogical proposal through guided tasks was based on two reasons: first, because of our direct interaction with students; second, because that would mark the participants' first contact with this type of pedagogical proposal.

4 The pedagogical proposal

The second proposal we developed, and which we will report in this text, was titled *Violence Against Women' and was inspired by a news article published on the website of the Brazilian House of Representatives (2022)*. The piece of news *Violence against women has a racial and income bias, activists warn: economic dependency and structural racism are pointed out as the main causes of the perpetuation of violence* (our translation), stated that incidents of violence against women in Brazil had a racial and income bias, according to activists. Moreover, it pointed out economic dependency and structural racism as the main causes of the phenomenon.

Published in April 2022, the article presented Raquel Mendes' point of view. She was the president of Artemis, a non-governmental organization. Mendes fought for policies to protect female victims of violence, and, in the text, she highlighted the need to use resources from *Benefício de Prestação Continuada* [BPC], as specified in *Lei Orgânica da Assistência Social* to aid women victims of violence and their children (Câmara dos Deputados, 2022).

The text also referred to other representatives who emphasized data on feminicides that took place at home by partners and ex-partners and to the lack of equipment to provide assistance to women near their homes, especially in peripheral neighborhoods, which hindered the full implementation of *Lei Maria da Penha*. Law number 11.340, from August 7th, 2006. (2006). Lei Maria da Penha. Brasília, DF. This is a well-known Brazilian law about women's rights aiming to protect them against violence. The name "Maria da Penha" is a tribute to a woman whose ex-husband tried to kill her twice. She became an activist. The first time, he shot her to simulate a robbery; in the second one, he tried to electrocute her while she was taking a shower. Due to the attacks suffered, Penha became paraplegic.

We chose the aforementioned theme for the pedagogical proposal because it was still a major phenomenon in Brazil. According to the data published by *Conselho Nacional de Justiça*[6] in 2022, around 640,867 feminicide or domestic violence lawsuits were filed in the Brazilian justice system. We believe that students in their process of development as citizens should discuss and reflect somehow on aspects related to these cases. Furthermore, data referring to the causes that push the phenomenon can be found on the website of *Instituto Brasileiro de Geografia e Estatística* [IBGE], and we consider public domain to be a useful tool to increase students' knowledge of the country's data providers and to support work with statistics teaching and learning because they are in line with the guidelines prescribed by BNCC (Brazil, 2018). For instance, it is possible to help them develop skills geared towards actions involving thinking, problematizing, planning, executing, implementing and communicating throughout a process of investigation and statistics, which is consistent with the perspectives put forward by Weiland (2017) for critical statistical literacy, aiming at the use of statistical investigations to communicate statistical information and arguments to destabilize and remodel structures of injustice in favor of a fairer society.

Thus, the aim of the pedagogical proposal was to encourage students to investigate whether the aspects presented by the news influenced the violence against women phenomenon or not. From this perspective, we will describe next how the proposal was employed. It is important to inform the readers of this text that throughout our work, we held discussions with students about statistical concepts, in which there were opportunities to stimulate reflections on the learning of the concepts and on the constructions they created. However, we decided not to discuss this aspect in this text because our focus is on the contributions to the development of

[6] Retrieved from: https://www.cnj.jus.br/wp-content/uploads/2023/08/relatorio-violencia-domestica-2023.pdf.

critical statistical literacy based on Weiland's (2017) structural framework.

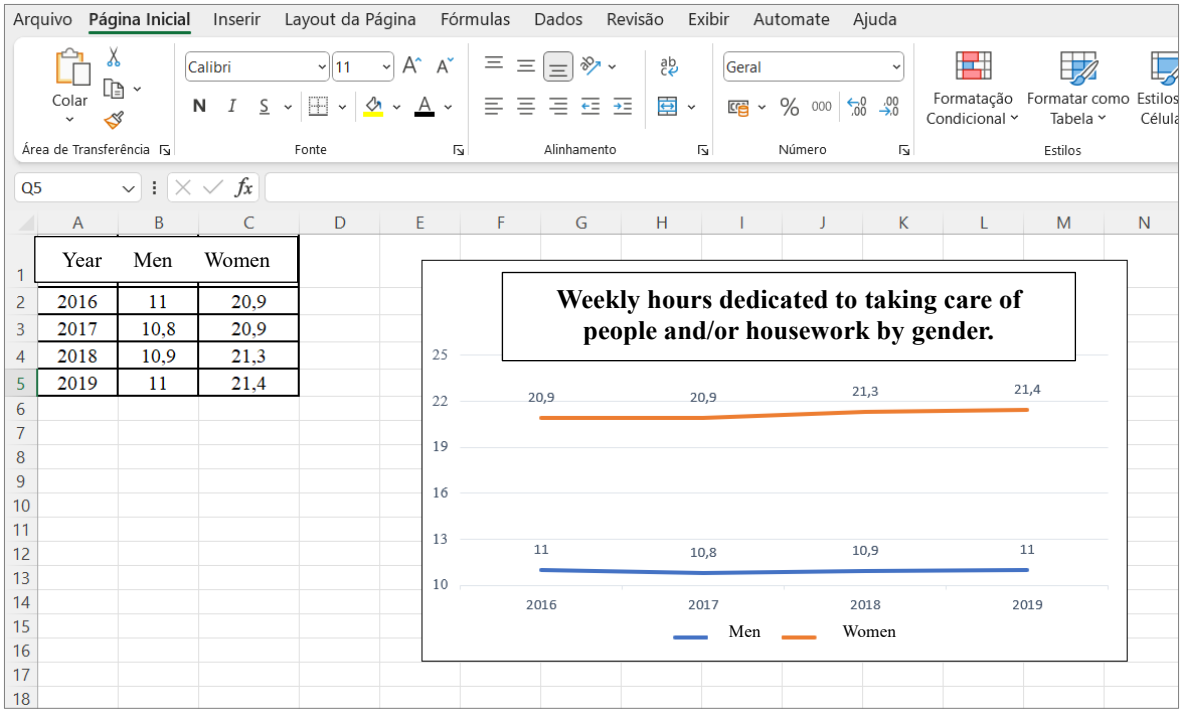
Firstly, we showed participants the image that accompanied the extract published on the aforementioned website. Next, three guiding questions were discussed: (a) What do you understand by violence against women?, (b) Do you believe there is a relationship between Mathematics and this news?, and (c) Regarding the presented context, do you know any place where we can verify the data related to this information?

Based on students' argumentation, we suggested visiting the website of *Instituto Brasileiro de Geografia e Estatística* [IBGE] and reflecting on the data found on the webpage. We also asked students to explore the webpage and observe the presented information. Following participants' reflections, we asked them to access gender statistics, in which they could find social indicators about women in Brazil.

Aided by Excel software and based on the table referring to Economic Structures[7], we instructed the students to take notes in their spreadsheets of the data on the average number of weekly hours people over 14 years old dedicated to taking care of people or doing housework, by gender, according to the Great Brazilian Regions and Federative Units — 2019, from 2016 to 2019 —, sorted by the average number of hours for men and women within that time window.

After they copied the data, we instructed them to build a graph just as they had done in the first pedagogical proposal, and we asked what type of graph would be more suitable for that kind of representation in order to understand students' previous knowledge. Based on the discussion, students decided that a line graph would be the best choice, as shown in Figure 1. After the graph had been built, we asked them what they could observe based on the data and on the construction of the graph. They observed that the average number of hours that women dedicated to the type of activity in question was always larger than men's hours.

Figure 1: Recorded data and graph created on an Excel spreadsheet based on the data referring to the number of weekly hours dedicated to taking care of people and/or housework by gender



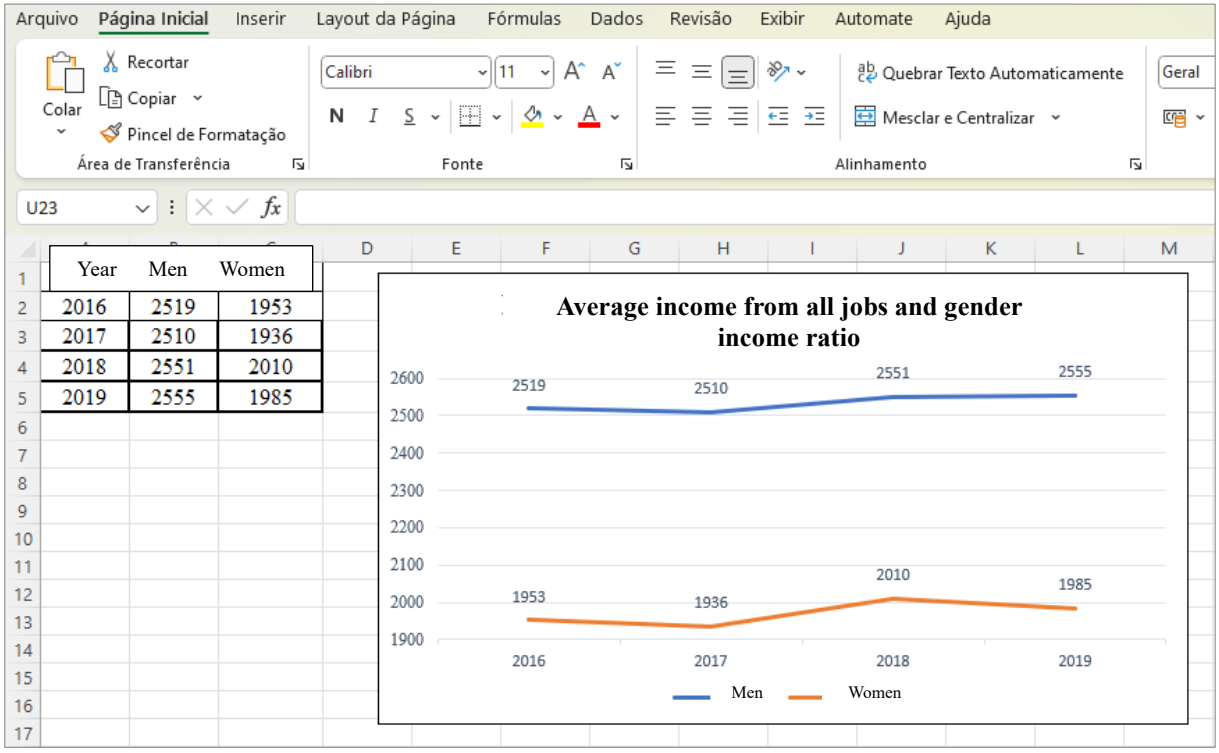
Source: Research collection, students' production

[7] Retrieved from https://ftp.ibge.gov.br.

Following students' reflections and still based on the same table about Economic Structures[8], we asked the students to record the data related to the income earned by individuals over 14 years old who were employed — by gender, with the coefficient of variation according to race/ethnicity and to geographic regions, 2019 (2016-2019) —, and then separate men and women.

Then, as we had previously done, we asked them what they could notice and told them to create a graph. The students understood that a line graph (Figure 2) was again the most suitable to represent their records and highlighted that men's average income in reais currency, within that time window, was always higher than women's.

Figure 2: Recorded data and graph created on an Excel spreadsheet based on the data referring to the average income from all jobs and gender income ratio



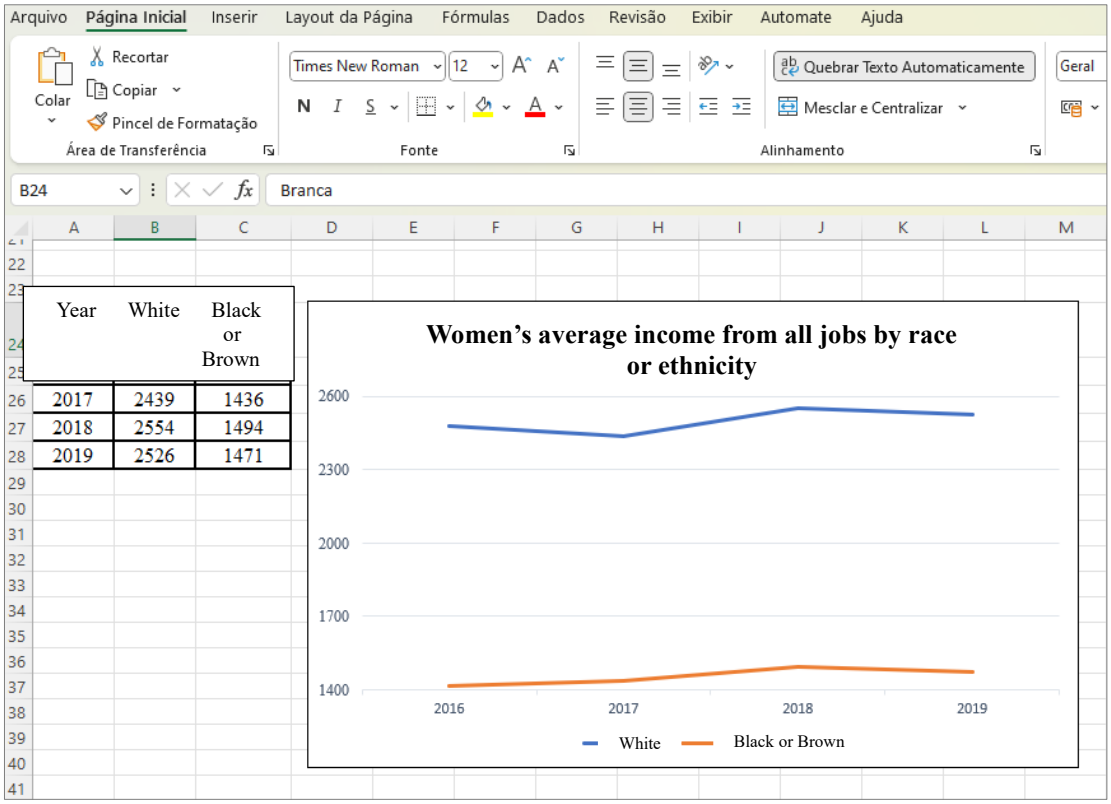
Source: Research collection, students' production

After the discussion, we asked them to copy the data referring to income, but this time they should focus on the female gender and separate women according to race or ethnicity. Then, we asked for a graph containing the data related to earnings (Figure 3). The students inferred that white women's average income was higher than black and brown women's.

In the next stage of the process, we instructed the students to observe the literacy rate of females by skin color or race and to take notes of the data that were also part of the Economic Structures table. We asked them to record them on their spreadsheets and then build the graph focusing on the literacy rate (Figure 4). From this perspective, while discussing the observed aspects, they compared white women and black and brown women and noticed a higher literacy rate among white women.

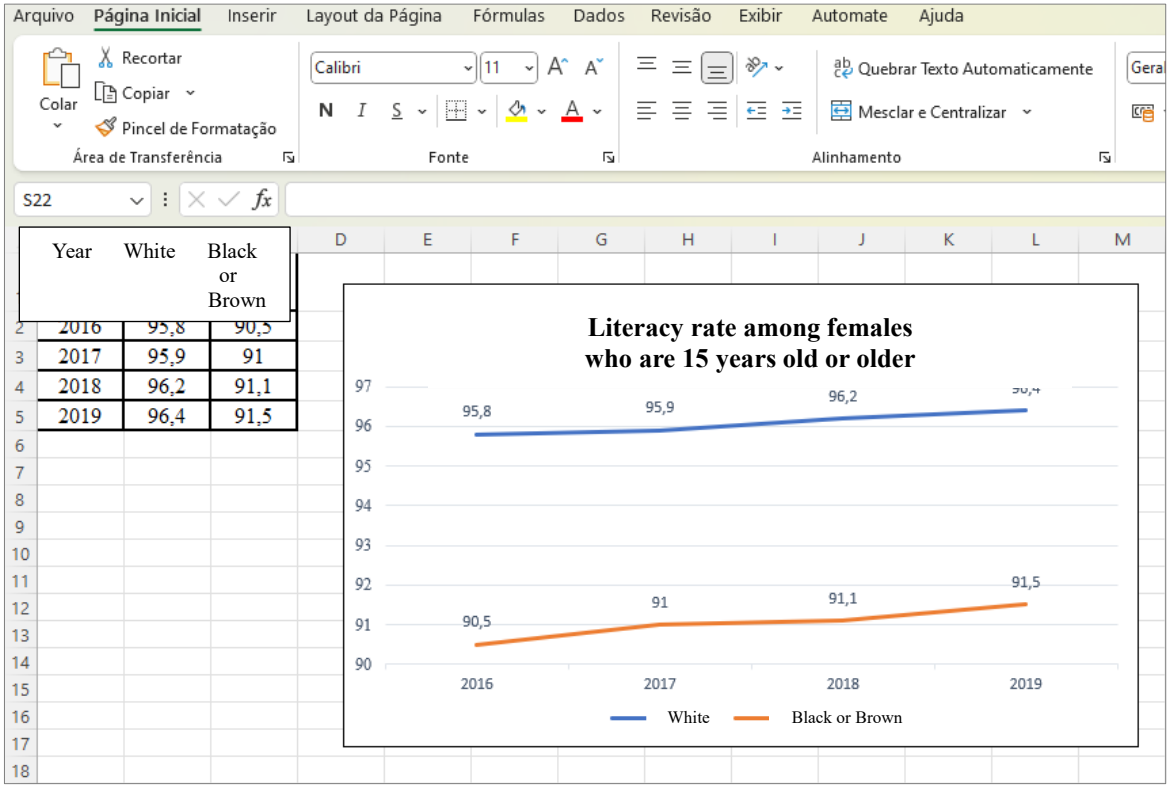
[8] Retrieved from: https://ftp.ibge.gov.br/Estatisticas_de_Genero/Indicadores_sociais_das_mulheres_no_Brasil_2a_edicao/xls/1_Estruturas_Economicas_xls.zip.

Figure 3: Recorded data and graph created on an Excel spreadsheet based on the data referring to the average income from all jobs — female gender only, by race or ethnicity



Source: Research collection, students' production

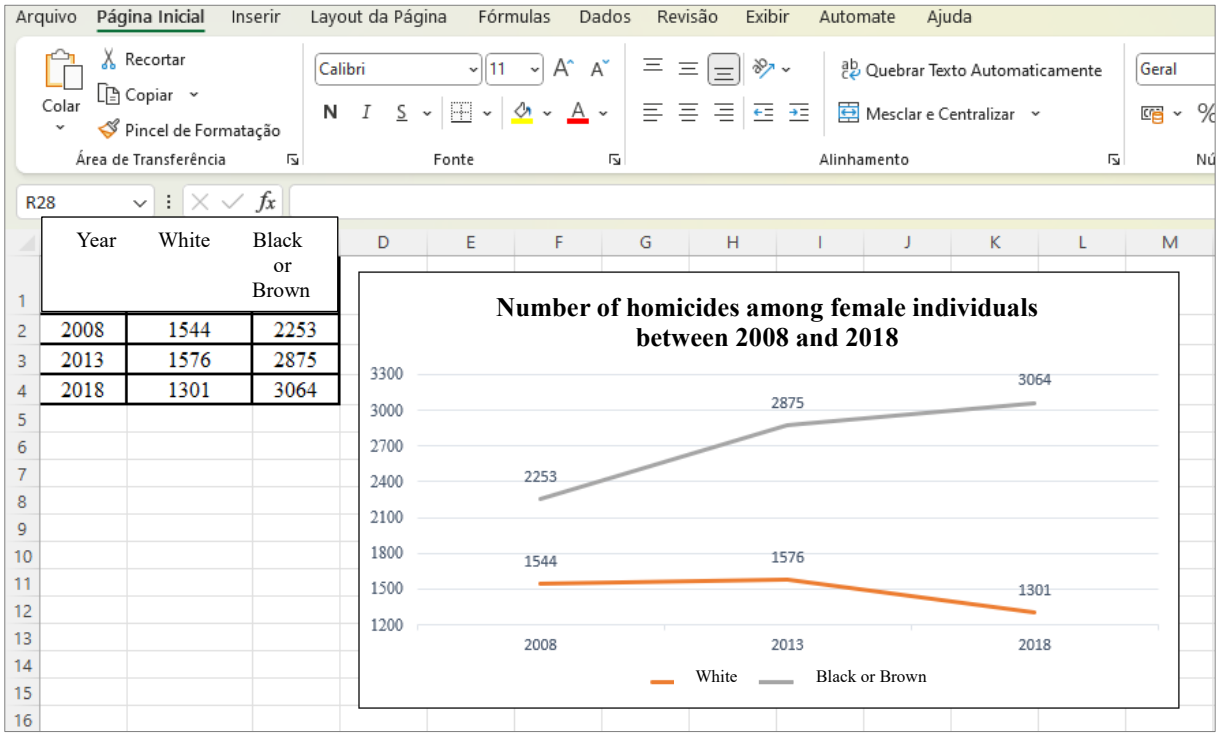
Figure 4: Recorded data and graph created on an Excel spreadsheet based on the data referring to the literacy rate among females who are 15 years old or older



Source: Research collection, students' production

Then, we instructed the students to analyze the data referring to the Human Rights[9] table, which was also produced by IBGE and presented on the same page as the previously mentioned social indicators about women in Brazil. Students were encouraged to observe the number of homicides among female individuals by skin color or race. Thus, they took notes of the data related to this aspect for 2008, 2013 and 2018 because the original table did not contain year-by-year data. The table and the construction of the graph based on the results (Figure 5) allowed students to notice that the homicide rate among black or brown women increased over the years, whereas it fell among white women.

Figure 5: Recorded data and graph created on an Excel spreadsheet based on the data referring to the number of homicides among female individuals by skin color or race



Source: Research collection, students' production

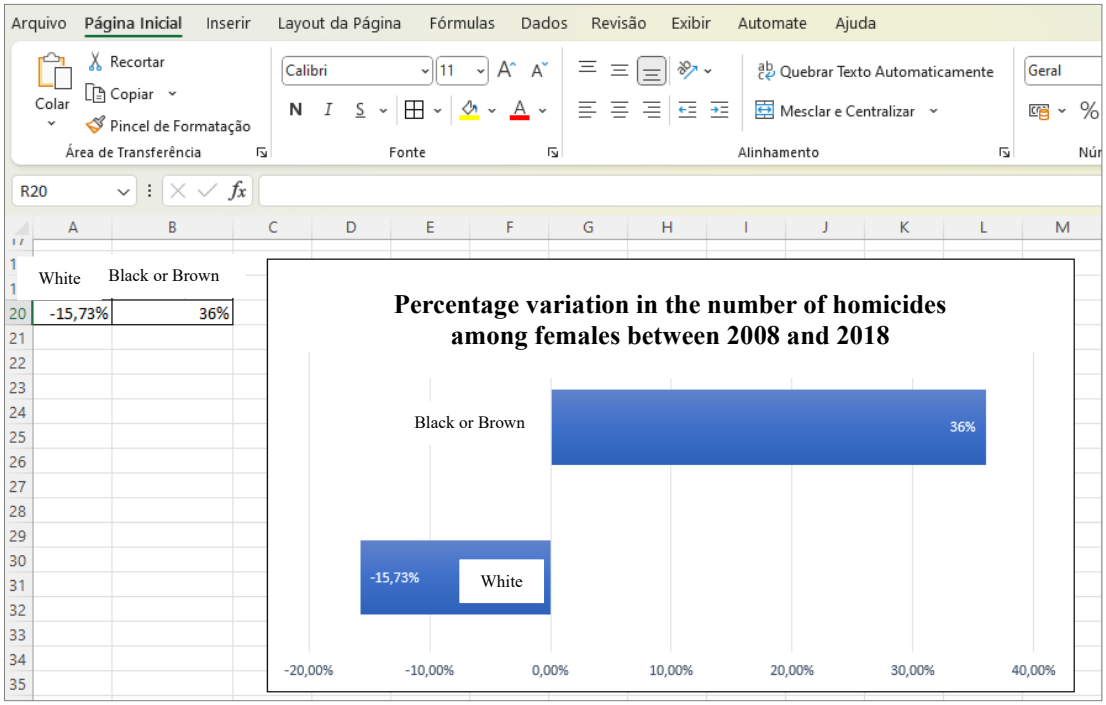
Following their observation, we encouraged the students to analyze the numbers while considering the growth rate in percentage. Based on the calculation of Growth = [(final value – initial value) / initial value] x 100, it was possible to verify that the percentage variation in the number of homicides among white females was -15.73% {[(1301 – 1544) / 1544] x 100}, whereas among black and brown females it increased 36% {[(3064 – 2253) / 2253] x 100}. After this step was completed, the students built a graph based on their calculations and observed what type of graph would me more suitable to report the data. Thus, as shown in Figure 6, after discussing the matter, they decided to build a bar graph because one of the values was negative.

To finish this stage of the investigation, we instructed the students to analyze what each of these data points regarding race or skin color represented in the population of murdered women in 2018. To do so, they performed the total sum of murdered women in the year in question based on the IBGE table, then they calculated the division of the number of murdered white women by the total sum of murdered women; next, they calculated the division of the number of black or brown women by the total sum of murdered women in the year. Thus, they

[9] Retrieved from https://ftp.ibge.gov.br.

verified that the number of murdered white women represented around 30% of the number of murdered women in 2018, whereas black or brown women represented 70%.

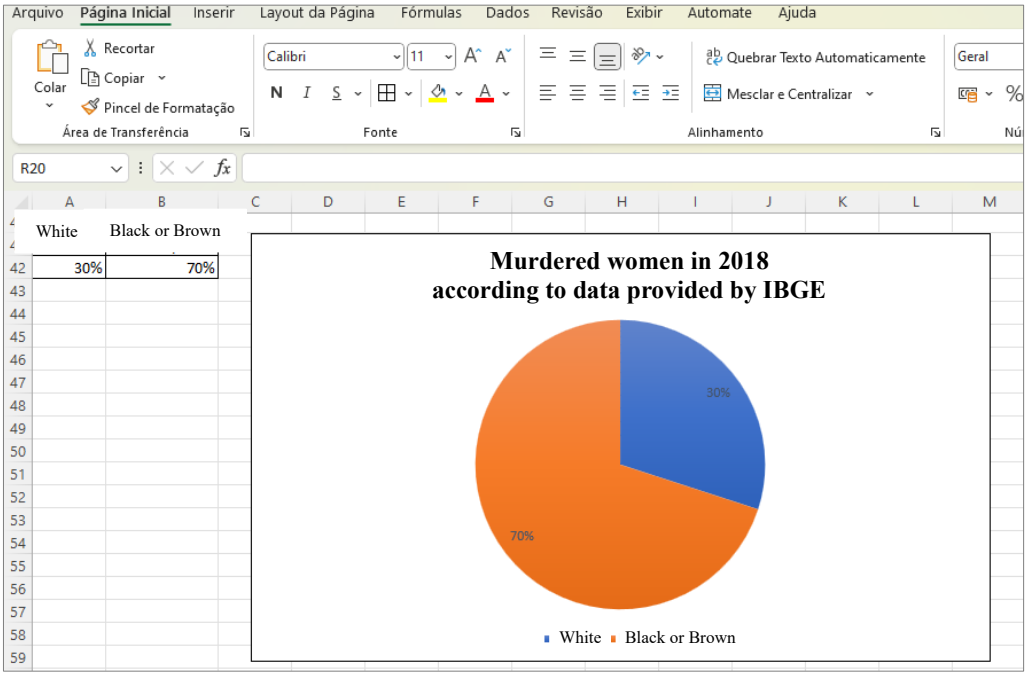
Figure 6: Recorded data and graph created on an Excel spreadsheet based on the data referring to the percentage variation in the number of homicides among females between 2008 and 2018



Source: Research collection, students' production

Moreover, for the construction of the graph, we asked what type of graph would be better to represent the data. As shown in Figure 7, the students preferred to use a pie chart because it could represent parts of a whole and percentages.

Figure 7: Recorded data and graph created on an Excel spreadsheet based on the data referring to the percentage of murdered women in 2018 according to data provided by IBGE



Source: Research collection, students' production

After the graph had been completed, I asked the participants to form groups of up to 3 students each to start working on the final task. Based on the collected data, graph constructions and on the news article, they should reflect on the conclusions they drew from the presented theme — violence against women — and produce a short video to express the group's viewpoint on the subject while presenting the collected data to support their argumentation. Even though the data referred to a time period before the publication of the news article, the groups should question whether they believed there had been any change in the observed setting or not.

The data collection referring to this investigation was carried out through three instruments: a video recording, which took place during the execution of the task and group interactions for the production of the video for the final task; the final videos created by the teams following the instructions they were given; and a logbook produced by the teacher/researcher, who kept records on the aspects that he considered relevant to the analysis. Next, we will present the findings that we encountered with the implementation of the pedagogical proposal. Our goal is to reflect on students' perceptions of whether the aspects presented in the news article influenced the phenomenon or not.

5 Results

Following the teacher's instructions, students formed five groups to produce the videos as a final task. They should reflect on the conclusions the group drew from the proposed theme — violence against women. To show the results, we adopted fictitious names to identify participants' individual arguments. Their names will be accompanied by tags G1, G2, G3, G4 and G5, which refer to the groups that students were part of. General references to the groups will be identified just by G1, G2, G3, G4 and G5.

Readers should be aware that groups were formed freely by the students themselves, who decided to establish the following compositions: G1 — Camila, Luisa and Debora; G2 — Ricardo, Pedro and Mariana; G3 — Bruno and José; G4 — Roberta and Leticia; and G5 — Juliana and Rafaela. The teacher decided to encourage students' moment as protagonists, avoiding any interference in the division.

The five groups produced the video on PowerPoint software in the form of a visual presentation of what they wanted to show featuring a narration by one of the group's members. Figure 8 shows the first slide of each of the five videos created by the students. They used the aforementioned software because they knew the tools it features and because there was a resource that allowed them to export the slide presentation as a video file.

Thus, the students created the visual part of the presentation as individual slides and employed the voice recording tool to produce the narration. Finally, they exported it and saved the file in a video format. When questioned by the teacher if they did not want to appear in the videos, all students said that they did not because, according to them, the final result would not be good. Furthermore, they mentioned shyness as a factor to avoid appearing in it [teacher's logbook entry].

Figure 8: Screenshots of the first slide of the videos produced by the students in the final task of the pedagogical proposal

Source: Research collection, students' production

Watching the videos produced by the students allowed us to observe that the five groups studied the theme — violence against women — and brought their viewpoints on the investigation. In addition, the five groups presented the graphs and tables they produced. First, we highlight extracts from the videos made by groups G1 and G4, who pointed out inequality as a factor influencing data and violence.

> […] as usual, we can see that gender inequality is also present in salaries. Regardless of the position they hold, men will always earn a higher salary. In society's eyes, women do not have enough capacity to hold the same position as men. Based on everything we've analyzed here and read in the news article, we reached the conclusion that we, women, live in an unfair place where we're stared at and judged by our gender and skin color. We live in a society in which we're not heard and don't have a place of speech. This is one of the main reasons why femicides have increased, and 81% of them were committed at home by partners or ex-partners. (G1 — final video task, Oct 25th, 2022, our translation)

> […] inequality is also evident in the second graph, in which men's average income is higher than women's, which contributes to gender inequality. Inequality is also present within the same gender, linked to skin color. When we look at women's average income from all jobs, it's possible to notice a significant difference between white women and black and brown women. As a final comment, we think it's important to say that racial and gender issues are some of the most important factors that contribute to all of this inequality, because besides having to fight against gender inequality, black and brown women still have to fight against racial inequality. (G4 — final video task, Oct 25th, 2022, our translation)

The groups identified gender inequality as an important aspect that directly influences

cases of violence against women. They used the graphs and tables that they built to illustrate their reflections. G4 emphasized that inequality also occurs in a subgroup within the same gender, in which skin color – in addition to gender – influences violence.

It was also possible to notice this inference during the first discussions we had throughout the development of the proposal. Regarding the question *What do you understand by violence against women?,* Juliana and Bruno said:

> I understand that, in this case, besides sexism, there's structural racism and the income factor, which leads us to understand that, in our country, if you're a woman from a low social level, you tend to suffer more violence. (Juliana — G5, video recording, Oct 25th, 2022, our translation)
>
> I believe it's not only physical violence, but also social violence. They have fewer opportunities. (Bruno — G3, video recording, Oct 25th, 2022, our translation)

Reflections upon the theme stemmed from students' previous knowledge of the theme and from the data collected during the investigation. In BNCC (Brazil, 2018), there is emphasis on a skill for statistics teaching in high school, which recommends developing the ability to interpret rates and indices of socioeconomic nature in order to investigate the process of calculating these numbers, analyze reality critically and produce arguments. Weiland (2017) suggests that the development of critical statistical literacy in writing should be based on investigations to communicate statistical information and arguments in an effort to destabilize and reshape structures of injustice.

Regarding the presence of statistics in this setting, we have noticed that students understand that mathematics and statistics are used within these contexts. When initially asked if there was a link between mathematics and the news article, they answered:

> Yes. Through these rates that they calculate about white, black and brown women, it's possible to identify color as a possible factor. (Bruno — G3: video recording, Oct 25th, 2022, our translation).
>
> Yes. In the comparison about skin color and income, a graph should be made to help us visualize it. (Camila — G1, video recording, Oct 25th, 2022, our translation).
>
> That's it. About violence levels against white women and black women, too. (Mariana — G2, video recording, Oct 25th, 2022, our translation).

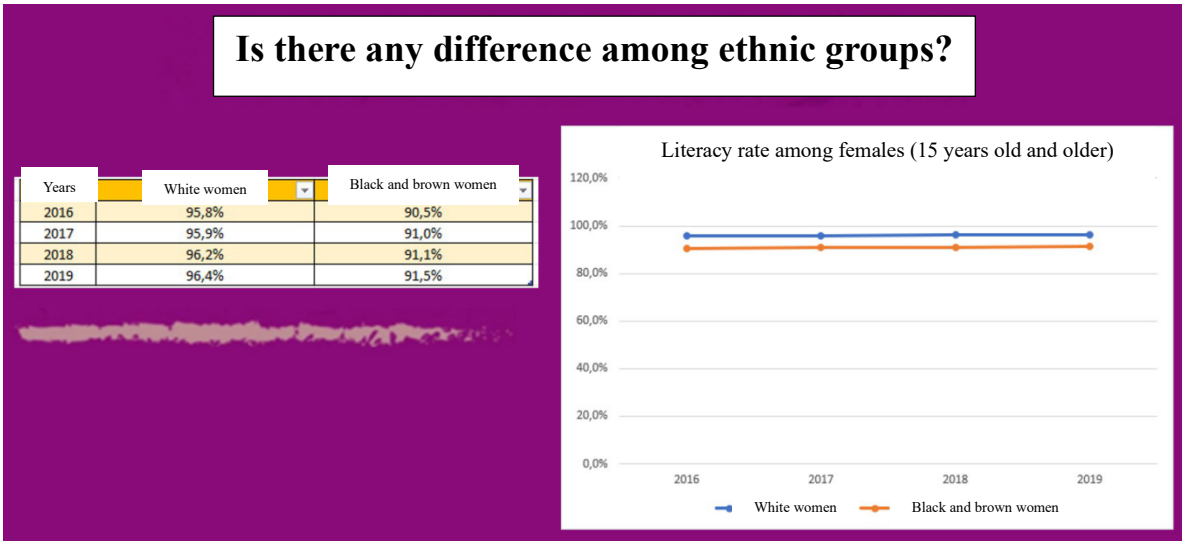
The students understood that mathematics is used as a tool to identify factors that cause inequalities. Moreover, it was possible to notice the use of mathematics and statistics to read and visualize the scenario. In their video, group G2 members stated that one can understand behavior in these settings through these resources.

> […] Violence against women has a racial and income bias, activists warn. Based on the data we collected on the website of IBGE, we statistically verified that this news tells the truth. […] Even among women, there's a striking difference regarding ethnicity. Wages, literacy rate and the number of murdered women can be divided according to ethnicity, and the result is shocking. By following the statistics, we could see that there's a higher literacy rate among white women. If we make a comparison from 2016 to 2019, there's a clear difference between white women and black and brown women, because there is a difference of over a thousand *reais*, depending on the year, and black and brown women earn less. […] In combination, statistics and mathematics provide a way so that we can visualize dynamically the differences among social groups, the ones who enjoy privileges and those who suffer prejudice because of their ethnicity. (G2 – final video task, Oct 25th, 2022, our translation)

Besides considering Mathematics and Statistics necessary tools to understand the

aforementioned settings, the students constructed graphs and tables over the course of the investigation to facilitate reflection on the identified situations, so that, in a simple way, the collected data and the findings could help make the information more comprehensible (Figure 9). About this aspect, in his structural framework for critical statistical literacy, more specifically in the section about reading, Weiland (2017) suggests that students should learn to identify and interrogate the social structures that shape us and says they could be exposed through data-based arguments.

Figure 9: Video produced by group G2 on violence against women.



Source: Research collection, students' production

When analyzing the video produced by group G5 for the final task, we observed that, at the end of the video, the students included a reflection that goes beyond the collected data:

> […] Through monitoring violence against women for the past 35 years, Brazil has reached an average rate of 5.13 brutal deaths per 100,000 Brazilian women. […] Based on the statistics, it is possible to notice that women are part of a less privileged group than men, but this difference is not limited to gender. In general, Brazil's historical and cultural context is directly interconnected with the situation in question. Alongside statistics, mathematics is a path to visually dynamically the differences among the social groups that clearly have different types of privileges or suffer some kind of prejudice based on their ethnicity. (G5 — final video task, Oct 25th 2022, our translation)

The students presented data beyond what had been collected in order to aid in the reflection pointed out by them. Although they did not mention the source, we verified that the referred information could be encountered on the website of JusBrasil[10], in an article from 2021 on *Lei Maria da Penha*. The students mentioned that Brazil's historical and cultural context is interconnected with the investigated scenario. This point was also addressed by a member of group G2 when the teacher/researcher asked what they could observe based on the graph representing the literacy rate among white women in comparison with black and brown women.

> [...] If we study history based on these data, it's clear that, for example, at the time of slavery in Brazil, literacy rates were strongly influenced because black people had little access to literacy. (Pedro — G2, video recording, Oct 25th, 2022, our translation).

[10] JusBrasil. A Lei Maria da Penha e os casos de feminicídio. (2021). Retrieved from: https://www.jusbrasil.com.br/artigos/a-lei-maria-da-penha-e-os-casos-de-feminicidio/1280311699.

In his structural framework for critical statistical literacy regarding writing, Weiland (2017) states that students should communicate their social location, subjectivity and political context to other students. Moreover, the author reveals how it shapes the construction of their own meaning of the world when reporting the results of a scientific investigation.

In summary, based on Weiland's (2017) structuring framework, it was possible to identify three dimensions for the development of critical statistical literacy, two of them being linked to writing and one to reading. Furthermore, we observed that the students used rates and indices of socioeconomic nature to investigate data and performed critical analysis to produce arguments with help from technological tools — actions that are in line with what is prescribed by BNCC [Brazil, 2018] for statistics teaching in high school; and their work involved real situations aiming at reinventing and opposing the sociopolitical positions that cause injustice, which is line with Weiland's (2017) ideas about the perspective of critical statistical literacy. In addition, there was students' critical and reflective engagement through the investigation, which is consistent with the theory proposed by Skovsmose (2008).

Thus, based on the presented information, we observed that the students understood that the factors pointed out by the original news article (economic dependency and structural racism) influence violence against women, so aspects related to critical statistical literacy were harnessed.

6 Conclusion

Based on the pedagogical proposal, we identified that the perspective of critical statistical literacy brings contributions to the processes of teaching and learning of statistics contents within school environments. Considering contexts that are part of daily life for reflection, alongside the process of reading and writing statistics, can contribute to students' development of the aforementioned literacy and also to their development as citizens because it leads them to understand settings that permeate their daily lives and to think of ways of positioning themselves in the situations in question.

Through the pedagogical proposal presented in this article, the students discussed a delicate theme in today's society, and, throughout the investigation, they collected data, constructed graphs and tables and used digital spreadsheets to understand the scenario. Moreover, they produced a video in which they reflected and presented their opinions on the theme. In addition to being in line with the perspective of critical statistical literacy, these actions are prescribed by BNCC for statistics teaching in high school. The results show that work performed from this perspective has the potential for inspiring mathematics teachers to create pedagogical proposals following the guidelines contained in Brazilian official documents for Education.

Despite the aforementioned contributions, it is necessary to consider that performing this type of work continuously in the classroom is not easy. There is little time available and a large number of contents in the mathematics curriculum, which are barriers to the daily implementation of the perspective.

The lack of pedagogical proposals based on this perspective for its implementation in the classroom and the lack of training to help teachers put it into practice in schools constitute some barriers that prevent the perspective in question from being carried out within curricula and educational spaces.

Thus, we pointed out that the aforementioned perspective brings contributions to statistics teaching in high school and that its implementation in classrooms should be

considered. Moreover, we highlighted the need for carrying out more studies focused on the theory approached in this article, so that knowledge could be expanded, and teachers and researchers could have more resources to put it into practice in their educational approaches.

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