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What can a subject called Mathematics Applications do?: students' voices on socioeconomic

¿Qué puede hacer una disciplina de Aplicaciones de las Matemáticas?: las voces de los estudiantes sobre cuestiones socioeconómicas

Que peut faire une discipline des applications mathématiques ? : voix des étudiants sur les questions socio-économiques

O que pode uma disciplina de Aplicações Matemáticas?: as vozes discentes sobre questões socioeconômicas

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Abstract

The aim of the current article is to address socioeconomic issues that have emerged in a Master's Degree research focused on investigating the discipline called "Mathematical Applications" taught in the 9th grade of Elementary School at a municipal school located in the outskirts of Campo Grande city, during the academic year in 2022. Excerpts from podcasts produced by students about discussions they held in classroom environment, about assignments proposed by the teacher, were analyzed. Participatory Research was herein adopted as methodology because the current study was carried out by a researcher who works as teacher in basic education schools and who would produce data based on using his own students. Data made available to students for the classroom assignment were herein presented along with

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excerpts from podcasts produced by them and with analysis based on theoretical-reference scholars in this field. The analyzed dialogues extended to a certain topic and, sometimes, students drew a parallel between these data and their own conditions, be them associated with sex, color/race, family income *per capita* or with the transportation type used by them. Tensions that eventually emerged in each scenario - given the multiple critical positions about the addressed topic - have enriched students' reflections and, consequently, enabled a meaningful learning process.

Keywords: Human rights, Subjects of rights, Inclusive mathematics education, Marginalized subjects.

Resumen

El objetivo de este artículo es traer reflexiones sobre cuestiones socioeconómicas que surgieron en una investigación de maestría que tuvo como campo la disciplina denominada Aplicaciones Matemáticas, en el noveno año de la Enseñanza Primaria en una escuela municipal de un barrio periférico de la ciudad de Campo Grande/MS, en el ciclo escolar 2022. Para ello, traeremos extractos de podcasts, producidos por los estudiantes, con discusiones que tuvieron en el aula sobre las actividades impartidas por el docente. Como se trata de un estudio en el que el investigador se desempeña como docente en escuelas de educación básica y produciría los datos con sus propios estudiantes, se utilizó como metodología la Investigación Participante. En este sentido, presentamos los datos puestos a disposición de los estudiantes en la actividad junto con extractos de los podcasts que produjeron y un análisis que reunió a teóricos del área. Así, fue posible notar que los diálogos se extendieron a un tema determinado, los estudiantes en ocasiones trazaron un paralelo entre los datos y sus propias condiciones, ya sea relacionadas con el sexo, color/raza, ingreso familiar per cápita o transporte utilizado. Las tensiones que eventualmente surgieron en cada escenario, dadas las múltiples posiciones críticas involucradas, enriquecieron las reflexiones y, en consecuencia, generaron aprendizajes más significativos.

Palabras clave: Derechos Humanos, Sujetos de derecho, Educación Matemática Inclusiva, Sujetos marginados.

Résumé

L'objectif de cet article est d'apporter une réflexion sur les questions socio-économiques qui ont émergé dans une recherche de maîtrise ayant pour domaine la discipline appelée Applications mathématiques, en 9e année d'école primaire dans une école municipale d'un quartier

périphérique de la ville de Campo Grande. /MS, au cours de l'année scolaire 2022. À cette fin, nous apporterons des extraits de podcasts, réalisés par les élèves, avec les discussions qu'ils ont eues en classe sur les activités données par l'enseignant. Comme il s'agit d'une étude dans laquelle le chercheur travaille en tant qu'enseignant dans des écoles d'enseignement de base et produirait les données avec ses propres élèves, nous avons utilisé la recherche participative comme méthodologie. En ce sens, nous présentons les données mises à disposition des étudiants dans le cadre de l'activité ainsi que des extraits des podcasts qu'ils ont réalisés et une analyse réunissant des théoriciens du domaine. Ainsi, il a été possible de constater que les dialogues s'étendaient à un certain thème, les étudiants faisaient parfois un parallèle entre les données et leurs propres conditions, qu'elles soient liées au sexe, à la couleur/race, au revenu familial par habitant ou au transport utilisé. Les tensions qui ont finalement émergé dans chaque scénario, compte tenu des multiples positions critiques impliquées, ont enrichi les réflexions et, par conséquent, ont donné lieu à un apprentissage plus significatif.

Mots-clés : Droits de l'homme, Sujets de droit, Enseignement inclusif des mathématiques, Sujets marginalisés.

Resumo

O objetivo deste artigo é trazer reflexões sobre questões socioeconômicas que emergiram em uma pesquisa de mestrado que teve como campo a disciplina denominada Aplicações Matemáticas, no 9° ano do Ensino Fundamental de uma escola municipal de um bairro periférico do município de Campo Grande/MS, no ano letivo de 2022. Para tanto, traremos excertos de *podcasts*, produzidos pelos alunos, com discussões que tiveram em sala de aula sobre as atividades dadas pelo professor. Por se tratar de um estudo em que o pesquisador trabalha como professor em escolas de educação básica e iria produzir os dados com seus próprios alunos, usamos a Pesquisa Participante como metodologia. Nessa direção, apresentamos os dados disponibilizados para os alunos na atividade juntamente com trechos dos podcasts que eles produziram e uma análise trazendo teóricos da área. Assim, foi possível perceber que os diálogos se estendiam em determinada temática, os alunos, por vezes, traçavam um paralelo dos dados às suas próprias condições, sejam elas relacionadas ao sexo, cor/raça, renda per capita familiar ou transporte utilizado. As tensões que eventualmente emergiram em cada cenário, diante dos múltiplos posicionamentos críticos ali envolvidos, enriqueciam as reflexões e, consequentemente, concebiam um aprendizado com mais significado.

Palavras-chave: Direitos humanos, Sujeitos de direito, Educação matemática inclusiva, Sujeitos marginalizados.

"All human beings are born free and equal in dignity and rights", says the first article of the Universal Declaration of Human Rights (UDHR). Yet, every human being has the right to education, among others (Organização das Nações Unidas, 1948). The Federal Constitution, which was influenced by the UDHR, provides, in its article 206, on the "equality of conditions for access and permanence at school; [...] free public education in official establishments" (Brasil, 1988, p. 188).

However, quality education is not limited to the right of access for all. It is also an intellectual, social and cultural emancipation process that, consequently, enables individuals' well-being. But does this emancipation process reach everyone? We do not believe it does. For some, this process is interrupted by socioeconomic issues, violence, deprivation of access to basic services (Arroyo, 2017) or by laws that advocate for mandatory access to Education, for example, but that still fail to guarantee individuals' permanence at schools.

We believe that offering a quality and equitable public school for all appears to be a good way to make it happen; however, there is still a lot to be done by the Brazilian State, mostly through effective public policies, for it to happen. Education seems to play an even more central role in fighting inequalities, mainly in countries like Brazil, which are geographically, economically and socially diverse.

The experience of social groups observed in public education brings marks of a State that has always denied them (or insufficiently offered them) the most basic rights, namely: the right to housing, to leisure and to be a child. Claiming for quality public schools is an act of resistance to support the lives of social groups that are constantly threatened (Arroyo, 2019).

Therefore, it is necessary acknowledging that poverty exists and that poor boys and girls reach the classrooms (Arroyo, 2018). From this perspective, and given the socioeconomic inequality scenario featuring society, the political role played by public schools cannot lie only on reproducing these inequalities through compensatory policies, but rather on promoting the proper conditions for individuals' instrumentalization in a moral, ethical and social transformation manner.

Public schools welcome children and adolescents who often suffer from poverty, from the violence surrounding their lives, as well as from lack of leisure and from deprivation of access to good services, among others, and who may carry the stigma of these attacks on their

own existences. Individuals who pursue a more decent and fair life at all costs put, in their studies, the hope of having their human rights respected in order to change this picture (Arroyo, 2017).

In light of the foregoing, the aim of the current article was to address socioeconomic issues that have emerged during the fieldwork conducted in a Master's Degree research developed in the Post-Graduation Program in Mathematics Education at Federal University of Mato Grosso do Sul. Data were produced in a discipline called "Mathematical Applications", taught in the 9th grade of Elementary School, at a municipal school located in a peripheral neighborhood of Campo Grande City/MS, during the 2022 academic year. We herein introduce the creation context of the aforementioned discipline, as well as excerpts from podcasts produced by students during this discipline's class. The excerpts encompass discussions about assignments proposed by the teacher, who is the third author of the current study.

This article starts with the following questions: "As Math teachers, how do we contribute to or think about the education provided to students? Is the socioeconomic context experienced by these students taken into consideration in the classroom? If so, what would students' participation in and the development of this discipline be like?"

The next section presents some reflections about public school and socioeconomic relations.

Education used as tool against social inequality

Based on the current legislation, the State of Rights is committed to acknowledge all individuals as dignified subjects of human rights at equality scale (Arroyo, 2019). However, we have the impression that both laws and documents accounting for ensuring quality and equity-based public schools only work on paper. The violation of the most basic rights, such as providing quality education for all, appears to be printed on problematic physical, material and human structures observed in part of Brazilian public schools. According to Arroyo (2019), the public school dismantling process and the violation of rights are entangled to the market logic, because investing in non-profitable lives – i.e., in threatened, peripheral and marginalized lives – does not make any sense in the capitalist culture, since it mainly focuses on profit.

Social inequality in our country is striking – "Brazil accounts for the highest wealth concentration in the world [...]"[4]. According to the 2023 Global Wealth Report, in 2022,

[4] Available at: https://link.ufms.br/fQUO8. Access on: November 14th, 2023.

approximately 48% of the global wealth was concentrated in the hands of 1% of the population and it has evidenced the existence of a most-favored minority and a majority living in social, economic and, consequently, educational chaos. Economic and social conditioning factors affect the lives of millions of children and young individuals worldwide. These factors cannot only affect the lives of the aforementioned individuals, but also the whole school system, within a class-inequality context (Connell, 2000).

According to Connell (2000), public schools have power over the lives of individuals inserted in it, either due to their obligation to attend it or to specific legal decisions they are subjected to. Accordingly, we understand that the public school both carries and reproduces obvious traits of a State that denies rights to poor children and young individuals. Individuals who attend public schools still see these institutions as the main carriers of hope for a better future, as well as for social, intellectual and moral ascension, among others (Connell, 2000).

Thus, public schools - given their complex composition - remain as place that welcomes children and young individuals with established rights. Social advancements that have led to this acknowledgement did not take place in separate, since they evolved together with other basic human rights, such as labor, housing and income, among others. These rights resulted from the struggles by social movements that put pressure on the State to reach such a progress. According to Arroyo (2019), if children and young individuals who get to school really have the status of subjects of rights, both schools and all their professionals have the obligation to guarantee these rights. The aforementioned author also questions whether attacks to public school are associated with the fact that this institution is a territory of rights.

Students' intellectual development is an important, although not the only, element in the teaching-learning process. It is essential taking into consideration students' experiences and social construction in this action. If teachers disregard the human figure and the marks left by their students' experiences, they automatically discard likely social oppression forms faced by these individuals and, consequently, they help impoverishing their learning process (Arroyo, 2017; 2019).

However, can the State meet this educational demand on its own? Is the State self-sufficient in fulfilling educational rights? Truth is that, despite their relevance at social sphere, educational rights do not materialize if children and young individuals do not have what is necessary to survive, and it turns the school institution into a no less important piece for the social construction of its students. According to Arroyo (2000), educational rights are

inseparable from many other rights, such as housing, food and affection, among others. Factors that sometimes seem obvious in the educational process are apparently not taken into consideration, such as the context children and young individuals attending public schools are inserted in. Understanding students' social, economic and family aspects, among others, is of paramount importance in teaching processes, since humanizing these individuals can help improving teaching fluidity (Arroyo, 2000).

Not only pedagogical, but also ethical and political questions become relevant for a context wherein basic rights are likely denied to students. According to Arroyo & Saraiva (2017), the exercise of knowledge about the history of education enables a critical understanding of human exploitation and of its violated rights.

Accordingly, the execution of established fundamental rights, the critical understanding of the environment the school and its specificities are inserted in, and equal access to knowledge, are ways to help reducing educational and socioeconomic disparities affecting education, mainly in public schools.

We understand that, besides being a logical and abstract reasoning discipline, Mathematics should also contribute to individuals' critical understanding about, and action in, the world. According to Ortigão (2005):

> Schools, at all levels, cannot only focus on conveying facts or information. [...] Ensuring that everyone can develop and expand their skills is essential to fight society's fragmentation, since it generates increasing inequalities. Thus, among the most important functions of teaching Mathematics, one finds teaching individuals to think, abstract, criticize, assess, make decisions, innovate, plan, make approximate calculations and use mathematical reasoning to understand the world, among others. (p. 37)

Ortigão (2005) advocates that Mathematics must be introduced as an open and dynamic science, to encourage students to participate in knowledge production processes, as well as to use knowledge to get adjusted to new situations, to acknowledge their logical-mathematical skills and to use them in problem-situations.

A recent study conducted by Mesquita (2020) has suggested the importance of socio-critical discussions in the process to develop mathematics contents involving topics linked to students' sociocultural context, since it establishes a straight relationship with their critical and reflective perspective about their own world. According to the aforementioned author, one must think about a contextualized Mathematics teaching process capable of covering students' entire field of interests based on adjustments in plans and actions aimed at their development - it may,

or not, use their socioeconomic or even cultural context (Mesquita, 2020). In addition, she advocates that another way to think about mathematical-knowledge contextualization lies on adjusting it to objects of knowledge deriving from other disciplines. It must be done within a process to break disciplinary boundaries to better understand different phenomena, of multiple natures, to open room for a disciplinary dialogue and, consequently, to solve issues associated with other disciplines, such as Physics, Biology, Chemistry, among others (Mesquita, 2020).

Is was possible seeing that both researchers, at different times, considered that teaching (Mathematics) should not be a fragmented, compartmentalized and mechanistic process aimed at knowledge transmission and accumulation, as well as the fulfillment of a common discipline matrix that disregards local realities and large-scale tests. We understand Education (Mathematics), based on the Freirean concepts, as an emancipating, humanizing and liberating social practice capable of promoting awareness by problematizing the world around us:

> This educational perspective brings along - in its essence - the likelihood of overcoming society-oppression conditions and relationships that annihilate human rights [...] Freire understands that education is not a neutral, but a political, process. He emphasizes that education is both a political and aesthetic act, as well as a given theory of knowledge put into practice (Malheiros, Forner & Souza, 2021, p. 6)

According to Freire (2015), knowledge cannot result from a passive act, since it is a constant and never static recreation process, through which individuals seek to understand things, based on their concerns about problems arising in their context. A Problematizing Education enables individuals to question both themselves and the world, and whether things can change:

The problematizing concept of education respects human nature, as well as perceives individuals as uniquely able to objectify space through praxis – which is the association between theory (thinking) and practice (acting) – to build their own understanding of reality (Pitano, 2017, p. 93).

From this perspective, given an unfair reality, according to which, social inequality reproduces and tends to perpetuate itself, it is possible using the learning path to build individuals conscious about their rights, as well as about what happens in their surroundings and in the world (Pitano, 2017). According to Freire (2019), education must be a transformative process. Although it is not the lever for social changes, these changes cannot take place without it. Thus, we understand education and mathematical knowledge as important factors to disclose reality for a given world reading.

The next section introduces the context of the process set to build a discipline called "Mathematical Applications". This discipline has been questioned by us since first time we heard of it. After all, what was the topic discussed in it that could not be discussed in traditional Mathematics?

Creating the "Mathematical Applications" discipline: some political issues

This section introduces the context of processes aimed at creating the aforementioned discipline. In order to better understand what led to its creation, we interviewed Professor Felipe[5]. He is member of the Elementary and High School Management Board (also known as GEFEM) of the Municipal Secretariat of Education (also known as SEMED) and effectively participated in the process to write the 2014 menu manuscript of the Curricular Standard of the Municipal Education Network of Campo Grande/MS (also known as REME).

Felipe has stressed that the National Education Council (CNE)/Basic Education Chamber (CEB) Opinion n. 18/2012, published in the Federal Official Gazette on August 1st, 2013, was the starting point to create this discipline. The aforementioned Opinion accounted for organizing the workload of Basic Education teachers. Teachers who worked 12 class hours, for example, had to dedicate 1/3 of this workload to planning. This discussion, and planning on how teachers' workload would be adjusted, took place at SEMED's scope, sometimes around 2013.

However, an issue emerged in the teaching workload-organization process due to the inaccuracy of a mathematical value observed at the time to calculate 1/3 (one third) of planning time over 20 hours a week of full working time. It is so, because 20 is not a multiple of 3. Thus, according to our interviewee, the Secretariat of Education has found two likely solutions, namely: teachers could work 14 hours in the classroom and 6 hours in planning classes. However, this alternative was denied by the teachers' union, which claimed that this model would bring loss to the teaching category, because the 1 hour expected to be used for planning goals would be used for teaching purposes. The clash between City Hall and Teachers' Union led to an agreement, according to which, teachers would work 13 hours in the classroom and the 7 remaining hours would be used for planning purposes.

[5] In order to guarantee the interviewed teacher's privacy, we will herein call him by the fictitious name Felipe.

After this definition process was over, it was necessary adjusting the disciplines' workload. However, SEMED, in Campo Grande City/MS, has got to the conclusion that any discipline was more important than the other and sought actions.

> [...] that would allow teachers to be assigned to this new organization. Thus, the following was done: the distribution of classrooms and a projection of yearly classroom distribution were taken as reference, since the nine-year primary education model had already been implemented at that time. We perceived that there were many sixth grade classrooms – in other words, we would need a larger number of teachers for the sixth grade. The seventh grade students would also require a large number of teachers. The eighth and ninth grades, in their turn, would not require many teachers, given the reduced number of classes. (Excerpt from Felipe's interview).

SEMED made the following adaptation in 2014 to adjust to the workload to this new context: the seventh grade, which previously had 4 Math classes a week, would now have 3 classes; and the sixth grade, which previously had 4 Math classes a week, would now have 5 classes. Thus, teachers would take 2 sixth-grade classes and 1 seventh-grade class, and it would total 13-hour teaching workload.

SEMED got to the conclusion that if the eighth and ninth grades remained with 4 classes each on a weekly basis (according to the old organization), it would be hard to close the teaching workload in a more diverse way, since it would be lower than, or exceed, the teaching workload per week. In order to solve this problem, the eighth grade remained with 4 Math classes a week. On the other hand, although the ninth grade remained with 3 Math classes a week, it has gained 1 class of Mathematical Applications a week. Thus, a single teacher could take 2 sixth-grade classes and 1 ninth-grade class. It could also take seventh- and ninth-grade classes, and this 1 Mathematical Applications class could still be taken by teachers who eventually took 3 eighth-grade classes, i.e., they would take 12 classes that could add to this 1 Mathematical Applications class in the ninth grade. Thus, Mathematical Applications was a discipline created to help completing teachers' workload, although the teacher in charge of teaching in the ninth grade is not necessarily the one teaching this specific discipline.

It is worth emphasizing that the interview with Felipe was conducted via Google Meet and that it was extremely necessary to help us understanding the reason for creating an additional discipline. We realized that it was necessary adjusting the teaching workload. However, Felipe told us that the discipline menu suggests building mathematical knowledge through both the investigation and resolution of problem-situations. In addition to encompassing thematic units, such as Numbers, Algebra, Geometry, Quantities and Measures,

Probability and Statistics, to associated skills and specific knowledge, it also makes explicit recommendations to teachers, such as proposing problem-situations involving the concept of interests or even involving proportionality and scales in socio-cultural and environmental contexts, among others.

From the perspective of a transformative education that helps both explaining and reading the world, it is necessary think about a Mathematics type capable of assuming its non-neutrality, as well as of bringing both reality and different contexts to the classroom. By keeping it in mind, and by exploring the workload of this discipline - which could have been done within the Mathematics discipline -, the third author of the current article decided to propose a new perspective and an analysis that goes beyond the classroom, which will be reported in the next section.

Methodological Choice

Decision was made to use Participatory Research as methodology because the current study's researcher works as teacher in basic education schools and because he would produce data based on using his own students. This research type is featured by interaction between the researcher and individuals participating in the investigated situation (Gil, 2002). Furthermore, it is worth highlighting "the educational dimension inherent to participatory research experiences" (Campos, 1984, p. 63).

From this perspective, we also understand that this research type is influenced by the Freirean methodology; therefore, it is closely linked to social issues and to interventions in the investigated environments. Moreover, it is in line with concepts that advocate for an education based on students' criticality development, be it in Mathematics or in any other discipline that takes into account students' context and that values their knowledge and practices.

According to Freire (2007), educators and students must walk side by side, and always establish symmetrical dialogue, so that students can recognize themselves as subjects of this process, as well as develop their curiosity, critical skills and understanding about a given topic. In addition, teachers who disregard the students' curiosity, aesthetic taste, desires and even their way of communicating, violate the ethical principles of their profession.

Accordingly, Skovsmose (2014) draws attention to the fact that Mathematics is capable of operating outside curricular references in education by opposing what is pre-determined to help better understanding its teaching process. One of the main challenges observed in

Mathematics teaching lies on making the mathematical knowledge construction process more meaningful. According to Campos (1984),

> Popular knowledge valorization, respect for knowledge construction pace and process [...], the transformation project that involves overcoming isolation and exclusion, and students seen as subjects of this process, all these elements are observed, whether with greater or lesser clarity, in participatory research experiences and proposals […] (p. 63)

Thus, we understand that Participatory Research can provide an environment conducive to critical thinking development based on symmetrical dialogue, through interaction between researchers/teachers and research participants/students.

Our investigation started with the visit of students from the ninth grade of Elementary School - who were enrolled in a municipal school located in a peripheral neighborhood of Campo Grande City/MS - to the campus of Federal Institute of Mato Grosso do Sul (IFMS). They were introduced to the Campus, as well as informed about students' admission form, offered courses, prerequisites necessary to participate in the selection exam, possible affirmative actions for admission purposes, the profile of each professional after graduation, likely activity fields, the composition of the 2023 selection exam, and about the important dates for those who choose to take this exam. The class in question comprised 36 students in the age group 14-15 years - most of them lived in the same neighborhood where the school is located in.

The visit was led by the Mathematics teacher, who is also the third author of the current article, together with teachers from other disciplines. During the visit, the teacher/researcher was impressed by students' reaction upon learning that IFMS was also a public school. One of them said: "Teacher, It looks like those schools we see in American movies." Students were dazzled, but they also felt that it was not a place for them; they did not believe they could belong to that place.

After returning to their school of origin, the Mathematical Applications researcher-teacher asked students to make critical analysis of graphs on the socioeconomic profile of IFMS students, from 2017 to 2019.

In order to do so, students were asked to get together in groups and to carry out podcasts[6] to record their reflections. Three different groups have analyzed the gathered data, which were herein presented without being separated per group. The podcast emerged as didactic and evaluative strategy proposed to students so they could record their responses/discussions in audio through a tool used by them in their everyday life. It is worth emphasizing that all herein used names were fictitious to protect students' identity.

Next section will introduce the report issued by a class in the discipline in question, as well as excerpts of ninth grade-students' speeches deriving from podcasts produced by them in

[6] Podcast is an audio recording of contents that can be transmitted through a file or streaming service.

the classroom. On that occasion, the teacher proposed the analysis of data available in the 28th edition of the magazine "*Perfil Socioeconômico de Campo Grande/MS*" [Socioeconomic Profile of Campo Grande City/MS], developed by the Municipal Agency for the Environment and Urban Planning (PLANURB), as well as in graphs plotted by researcher Higor Cirilo, at the Territorial Planning and Management Laboratory (also known as LAPA)[7], Federal University of Mato Grosso do Sul (UFMS). The teacher's proposal lied on working with students on the topic "Ratio", in addition to reviewing topics such as Numbers (percentages) and Information Processing (graphs).

A discussion and analysis exercise

The class started with the teacher presenting to students PLANURB data on income *per capita* of the population living in Campo Grande/MS, based on the 2010 Census. In order to do so, the teacher presented tables with the value of this income per neighborhood, in Reais, together with the graph shown in Figure 1. Because 'Ratio' was the topic addressed in the Mathematical Applications discipline, he explained to students how these data were calculated:

Income *per capita* = Total nominal monthly income of permanent private households divided by the total number of dwellers living in the neighborhood.

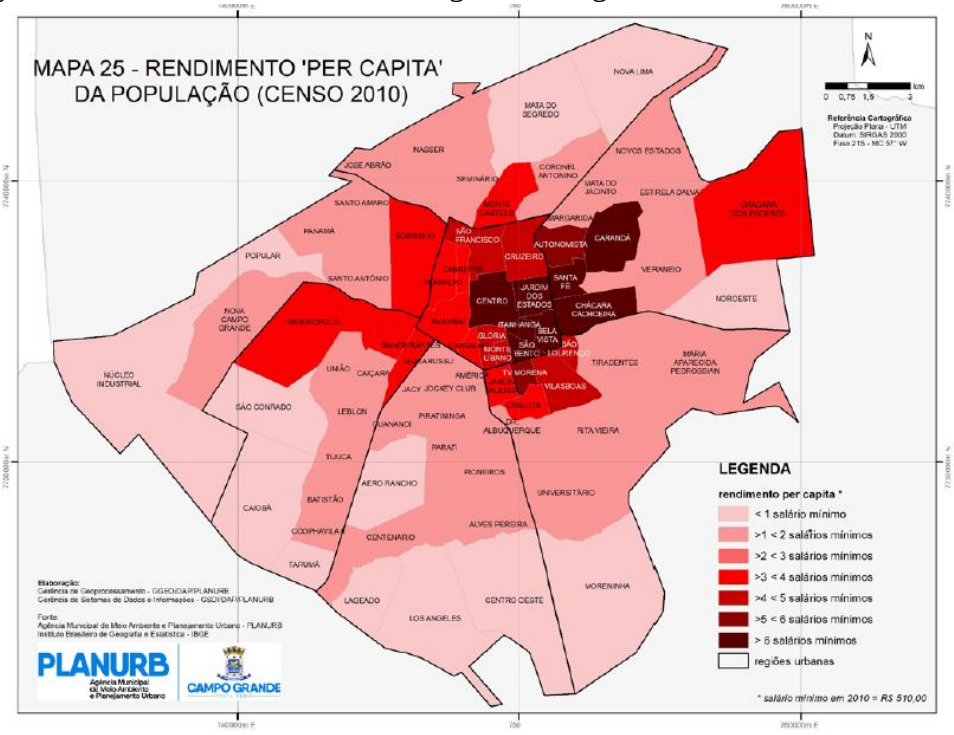


Figure 1.

Graph showing income per capita in Campo Grande City/MS, based on colors (PLANURB[8])

[7] Available at: https://www.campograndenews.com.br/cidades/capital/mais-ricos-ate-vivem-na-periferia-mas-dentro-dos-condominios-de-luxo. Access on: June 20th, 2023.

[8] Available at: https://www.campogrande.ms.gov.br/planurb/downloads/perfil-socioeconomico-de-campo-grande-edicao-2021/ Access on: August 11th, 2023. Image description: Map #25 referring to the population's

The teacher asked students to observe each region in the graph and asked them to assess the income *per capita* of the depicted neighborhoods, mainly that of the one they lived in, in comparison to the downtown area. He also asked whether it influenced their lives and learning process.

> **Gabriel:** I think it makes more sense to oscillate in the downtown area due to its economic movement, for example, when a place starts to be urbanized and people start coming from the hinterlands.
> **Anderson:** People do not have financial income.
> **Gabriel:** It is true. So, they often look for cheaper places to live in and the most populous places tend to be the poorest places in the periphery. This is how it is, right? Consequently, the downtown area ends up hosting the most select group.
> **Melissa:** It is like comparing the rent of a house in the downtown area to that of a house here, in peripheral neighborhoods; it is totally different. It could be a house with the same structure, but the price will be very different because houses in the downtown area are close to places like shopping malls and stores. So, is it really different? Real estate appreciation requires analyzing several contexts.

It was possible seeing that, although these students were young, they were able to use the capitalist logic to understand that some places in the city were more financially valued than others and intended for a select public, whereas other places, which had less infrastructure and were less privileged in terms of commerce and leisure, aimed at the poorest public. According to Arroyo (2019), the market logic lies on investing in profitable lives, rather than in unprofitable, threatened, peripheral and marginalized lives. However, we believe that the market logic thrives even in the poorest regions of cities, since many profit forms are also explored in these places.

No doubt, this context affects the school issue, since schools located in these places often face difficulties, such as lack of teachers, problematic or insufficient infrastructure, scarce financial resources, insufficient didactic-pedagogical resources and violence, among others. Yet, this context has straight impact on the quality of learning in these schools. With respect to its likely influence on students' life or learning process, Marcos (a student) said:

> [...] rich individuals who study in private schools can have a more advanced education, you know? They can go to college and attend a much better course, sooner. Given their

income *per capita* - 2010 Census. The legend refers to income *per capita*: lighter colors refer to lower amount of minimum wages. For example, the lightest color in the first line of the legend refers to people who earn less than one minimum wage; the second line refers to people who earn from 1 to 2 minimum wages; the third line refers to people who earn from 2 to 3 minimum wages; the fourth line refers to people who earn from 3 to 4 minimum wages; the fifth line refers to people who earn from 4 to 5 minimum wages; the sixth line corresponds to people who earn from 5 to 6 minimum wages and; finally, the darkest color refers to people who earn more than 6 minimum wages. It is worth emphasizing that the minimum wage in Brazil corresponded to R$ 510.00s, at the time this Census was carried out.

> age, around 15 years old, they will be able to attend a much better course than a paid course, do you understand? And they can have opportunities [...]

According to this student, someone with better financial status can have access to a better school, attend a good university and, consequently, have more opportunities in life.

Although statements, such as "better school/university" and "good opportunities", are weighty, we cannot deny that this dynamic is significantly embedded in our society. According to Rodrigues (2017), privileges of wealthier classes are also maintained through the conservation, although veiled, of the organization of a school type aimed at those historically known for studying at the best universities and for getting the best jobs. On the other hand, these is another school type focused on the poorest classes that often fail to reach a college degree and, when they do so, they do not always attend quality institutions; consequently, they get lower job positions.

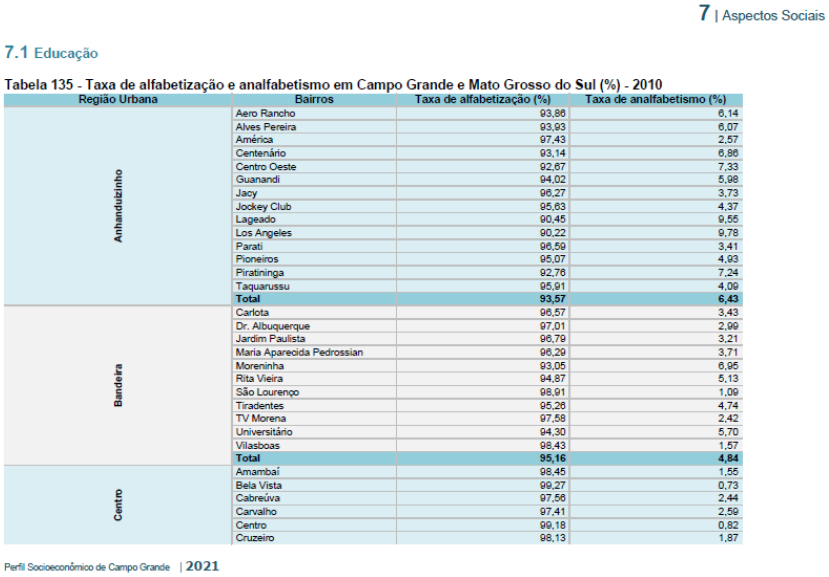
Accordingly, Arroyo (2019) highlights a quantitative, more favored minority and a large majority in the midst of social, economic and, consequently, educational chaos. This dynamics only changes when someone from the poorest stratum makes an individual effort and goes out of its way to overcome difficulties and to break this cycle.

It is important emphasizing that the quota-policy implemented in our country was an attempted to respond to this scenario. It is an affirmative action aimed at developing

> [...] principles aimed at fighting discrimination by establishing differentiated standards and criteria to enable access to certain goods or services by individuals belonging to specific groups, mostly by vulnerable groups, based on the ideal of equal access, regardless of individuals' ethnic, racial, social or gender origin. (Silva, 2017, p. 822)

However, quotas only minimize the effects of a perverse dynamics. In addition, we understand that the State must not only guarantee educational rights – by providing quality school and fairer ways for the poorest individuals to access quality universities – but also other fundamental rights, such as housing, labor, health, food and affection, among others, so real changes can take place.

Subsequently, the teacher presented a table of literacy and illiteracy rate (in percentage) per neighborhood:



7 | Aspectos Sociais

7.1 Educação

Tabela 135 - Taxa de alfabetização e analfabetismo em Campo Grande e Mato Grosso do Sul (%) - 2010

Região Urbana	Bairros	Taxa de alfabetização (%)	Taxa de analfabetismo (%)
Anhanduizinho	Aero Rancho	93,86	6,14
	Alves Pereira	93,93	6,07
	América	97,43	2,57
	Centenário	93,14	6,86
	Centro Oeste	92,67	7,33
	Guanandi	94,02	5,98
	Jacy	96,27	3,73
	Jockey Club	95,63	4,37
	Lageado	90,45	9,55
	Los Angeles	90,22	9,78
	Parati	96,59	3,41
	Pioneiros	95,07	4,93
	Piratininga	92,76	7,24
	Taquarussu	95,91	4,09
	Total	**93,57**	**6,43**
Bandeira	Carlota	96,57	3,43
	Dr. Albuquerque	97,01	2,99
	Jardim Paulista	96,79	3,21
	Maria Aparecida Pedrossian	96,29	3,71
	Moreninha	93,05	6,95
	Rita Vieira	94,87	5,13
	São Lourenço	98,91	1,09
	Tiradentes	95,26	4,74
	TV Morena	97,58	2,42
	Universitário	94,30	5,70
	Vilasboas	98,43	1,57
	Total	**95,16**	**4,84**
Centro	Amambaí	98,45	1,55
	Bela Vista	99,27	0,73
	Cabreúva	97,56	2,44
	Carvalho	97,41	2,59
	Centro	99,18	0,82
	Cruzeiro	98,13	1,87

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Figure 2.

Data referring to literacy and illiteracy rates per region and neighborhood, in separate (PLANURB[9])

Because Mathematical Applications' content also addresses percentages, he explained to students how these data were calculated:

Literacy (or illiteracy) rate = Number of literate (or non-literate) individuals divided by the total number of dwellers in the neighborhood (x 100)

After observing the table, students were invited to think about the association between the aforementioned rates and income *per capita*, as well as about whether it could be an aggravating factor in students' education:

> **Gabriel:** The literacy rate is closely linked to poverty and education. Overall, when a person has little income, it has a hard time taking its children to school, either due to transportation issues or to many other things, perhaps.
> **Melissa:** Sometimes, the person lives in very poor places, lives in a rural area and the school is very far away [from its home]. For these reasons, children sometimes also have to start working to help their families because their income is very low. And since it [the school] is too far away, they end up quitting it. I think this is something that increases a lot the illiteracy rate.
> **Anderson:** Overall, people who have very low income try to moonlight a lot; consequently, they do not have much time to take their children to certain places, such as to school.

[9] Image description: Table #135 – Literacy and Illiteracy Rate in Campo Grande City, Mato Grosso do Sul State (Brazil), 2010. The first column refers to the urban region's name: the first two regions are peripheral areas; the third region is the downtown area. The second column presents the names of neighborhoods located in each of these regions. The third column presents the literacy rate (in percentage) in each of these neighborhoods. Finally, the last column refers to the illiteracy rate (in percentage) per neighborhood. We emphasize that this table was published in 2021

These excerpts show that, despite their young age, these students understand that families belonging to the poorest classes have a hard time keeping their children at school, often due to low income, lack of transport, because they live in distant places or because the family needs these young individuals' income to survive, among others.

These young students understand that the State cannot meet the educational demand and that individuals' rights do not materialize, since many of them even have a hard time getting what they need to survive. Moreover, they understand, in practice, what Arroyo (2000) theoretically states, namely: that educational rights cannot be separated from other rights. However, it does not appear to be taken into consideration in the context these children and young individuals are inserted in. Thus, social, economic and family contexts, among others, should be taken into account in teaching practice, since these individuals' humanization can 'dialogue' with teaching fluidity. (Arroyo, 2000)

According to Arroyo & Saraiva (2017), the old condemnation of the poor for their delay, as well as for their lack of work, savings and schooling, lies behind proposals to fight poverty. Thus, association between education and poverty are addressed in these proposals, which still see education as likely saving factor:

> [...] salvationist proposals are losing believers among educators/teachers working with poor populations, as well as among social groups condemned to poverty, unemployment, and to live in the most inhuman places in urban peripheries. They do not see themselves as lacking work value, but as lacking jobs. They do not see themselves as lacking savings values, but as lacking income, land, housing and the right to live in a just and human way. They do not see themselves as marginal, but as excluded individuals. Socio-educational policies feed on dichotomies (poverty-wealth, delay-development, exclusion-inclusion, vulnerable-healthy) determined by the negative factor to be overcome, and by the positive factor everyone will be able to reach through education, which is the route enabling them to be included in the wealth, development and non-vulnerability territory. Radical class dichotomies, such as justice-injustice, are left out of these proposals. (p. 149-150)

Vinícius (a student) expressed his opinion about the quality of studies associated with income *per capita* when he was questioned about it:

> [...] the person has no money; it cannot go to a good school because most poor people study in public schools, whereas those with better financial status go to private schools. I think it happens sometimes because a bricklayer, for example, does not need to be literate in order to work, but it earns very little money; and when people go to school, it gets much, much better jobs, because of income and education. It is better this way.

We are faced with Vinicius' realization that, in line with Arroyo & Saraiva (2017), part of society is condemned to poverty, unemployment or underemployment, and to live in the most inhuman places in urban peripheries. We can also see the discourse that education leads to social ascension. Maybe Vinicius, himself, hopes that the school can lead him to a better future, as well as to social, intellectual and moral ascension, among others (CONNELL, 2000).

Obviously, we are not claiming that he and other boys and girls from the poorest layers cannot achieve social ascension through education. What we want to say is that attending school is not synonymous with this ascension, because these individuals will have many other obstacles to overcome, both in and outside the school environment.

Melissa and Gabriel kept on talking about this topic and brought their family experiences into this context:

> **Melissa:** My father quitted school very early in life, because he had to work to help his family. He started working very early, at 11 or 12 years old, because his family was very poor and had a lot of children; thus, he totally lost his studies. He quitted school when he was in the seventh grade and he does not know many things due to lack of study, because of poverty.
> **Gabriel:** For his grandparents, it was even harder to have access to education. They had this even stronger need to start working early in life. It was a much more extreme situation, and it highlights even more the issue we are talking: those who start working early in life do not have easy access to education; that is basically what ends up generating this situation.

Students also understand that their parents and grandparents' need to start working early in life was a factor preventing them from remaining at school and, consequently, from reaching higher schooling. However, it is important emphasizing that this factor remains a sad reality in our country. This is the topic of discussions held by several authors mentioned in the current study, such as Rodrigues (2017), according to whom, the need to work and, consequently, to quit school – which is the reality of many boys and girls from poor families – is configured as exclusion mechanism in school environment.

Finally, the teacher presented four extra graphs to the students. These graphs were developed by researcher Higor Cirilo, from UFMS, and they show Campo Grande City/MS divided in neighborhoods. These neighborhoods are highlighted in colors that represent where the income was concentrated in, the richest 10%, the time necessary to travel by foot to a health unit and, finally, the factor that caught students' attention the most: where the black population is concentrated in (Figure 3).

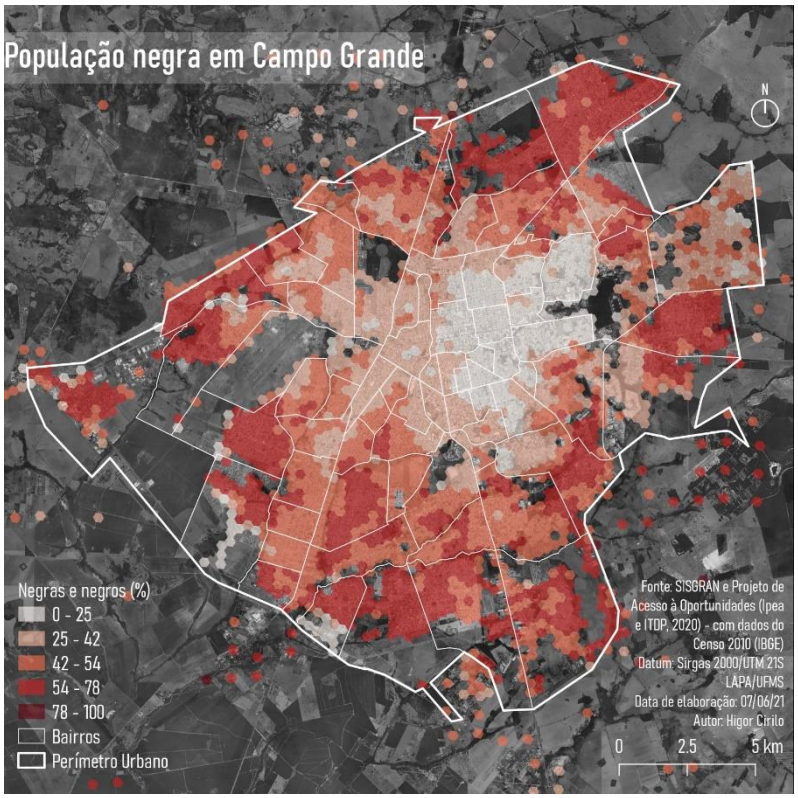

Figure 3.

Concentration of black people in Campo Grande City/MS (Higor Cirilo (LAPA/UFMS[10]))

After observing the chart presented above and being questioned by another student about why black people are mostly concentrated in peripheral regions of the city, Welington (a student) replied:

> I believe it is because of slavery, right? Because slavery has stained black people; they were the most enslaved ones. Very few whites were enslaved. So it left this mark, right? The black race was marked by slavery, right? So they are more excluded from studies, from jobs capable of generating higher income, blacks do not get things very easy, because they were enslaved; the whites get these things easier because they have higher income.

Welington was asked again: “Do you think the government neglected black people by not providing support to them, later on, after racial segregation was over?” And he replied: "Yes, because things have to be fair, right, blacks and whites must have equal rights, because we are also humans, right?” According to Almeida (2019), racial discrimination “[...] is the attribution of differentiated treatment to members of racially identified groups” (p. 23) and

[10] Image description: Figure #3 refers to the map of black population concentration in Campo Grande City. The clearest color in this map corresponds to the smallest concentration of black people in this region. According to the caption, the white color corresponds to 0-25% of black people in the region; light pink refers to 25-42% of black people; the most orange color - a little more away from the center - corresponds 42-54% of black people; the region in red corresponds to 54-78%; and the region with the darkest color (fifth line in the caption) corresponds to 78-100% of black men or women.

discriminatory practices observed overtime, be them direct or indirect, have lead "[...] to social stratification, which is an intergenerational phenomenon, according to which, the life path of all members of a given social group [...]" (p. 23) affects their chances of social ascension, acknowledgement and material support. The aforementioned author points out two discrimination types: the negative one, which results in damage and disadvantages; and the positive one, which lies on a different treatment applied to historically subordinate groups with the purpose to fix disadvantages caused by negative discrimination, such as affirmative action policies (Silva, 2019).

According to Goes et al (2021):

> [...] Based on the 2010 Census, which is the basis of the study we refer to, there were 11,425,644 people distributed in 6,329 peripheries across the country; 30.6% of them were white and 68.6% were black. We do not believe in coincidences, and we herein restate the common sense that shantytowns are mostly inhabited by blacks. Data analyzed in the research put, once again, a magnifying glass on structural racism in Brazilian society and leads us to revisit both the big house and the slave quarters that, ideologically, persist to this day. If there is still doubt about it, I'll explain: downtown areas are the big house, whereas peripheries are the slave quarters, themselves. Once again, "we do not believe in coincidences". Shantytowns are the consequence of an exclusionary and racist society. (p. 16)

This quote provides data that firstly point towards the spatial division of races, to a quantitative majority of black people living in peripheries. Almeida (2019) stresses that racism, which materializes itself as racial discrimination and articulates with racial segregation, is not just an act or set of discriminatory acts, but a process, according to which, subordination and privilege conditions, which are distributed among racial groups, end up being reproduced at political, economic and daily-relations scopes.

Moreover, structural racism[11] is rooted in society formation and it emerges in places where there is preference for a given race or ethnic group over the others, where there is prejudice and discrimination, or in places crossed by the racial issue. It permeates the collective unconscious and can be seen in personal relationships, public policies and economic inequalities, among others. It is essential enabling young black people to choose their academic careers and guaranteeing both the opportunities and conditions associated with education, to help dismantling structural racism. We herein emphasize, again, the minimization of this practice's effects based on the implementation of racial quotas; however, it is necessary guaranteeing fundamental rights to all Brazilian citizens.

Final Considerations

[11] According to Silva (2019), "racism derives from the social structure, itself, i.e., from the "normal" way political, economic, legal and even family relationships are formed; it is neither a social pathology nor an institutional disorder" (p. 33).

What can a discipline do? What if it is titled ‘Mathematical Applications’? We believe that it can break disciplinary boundaries and work in between, by not only moving into other knowledge fields, but also by mobilizing new knowledge and knowledge from non-school spaces. Furthermore, it provides critical reflections to help students understanding that they are part of society, as well as to enable them to connect to the market, capital and exclusion logics.

Mathematics is a very powerful field; thus, “Mathematical Applications” also enables building mathematical knowledge, although in a less abstract and more meaningful way. It is so, because, when students have the opportunity to analyze data about the context they live in, they recognize themselves as part of these data and issues.

This discipline also has the potential to be used for social mobilization purposes, since some students - upon understanding that the socioeconomic conditions they and their families live in will not change - can try to find ways to twist this dynamics. After reflecting in class, analyzing data and sharing experiences, they realized that there is an excluding society.

We observed that, once the dialogues extended to a certain topic, students sometimes drew a parallel between the analyzed data and their own conditions, be them related to sex, color/race, family income *per capita* or transportation type used by them. Tensions that eventually emerged in each scenario, given the multiple critical positions involved in it, have enriched these reflections and, consequently, enabled a more significant learning process.

A discipline, whatever it may be and regardless of the political intentions behind its creation - which, in our case, was the need to adapt teaching hours - can do a lot. We started this article with questions and, upon looking at what was produced in the discipline in question, we can see that, as Mathematics teachers, we can contribute to a transformative education by taking students as active subjects in pursuit of knowledge, based on their own concerns and experiences (Freire, 2015; 2017). From this perspective, the socioeconomic context experienced by students must be taken into consideration in the classroom. Likewise, attention must be paid to the learning produced in non-school environments and it must be addressed in the classroom, even in Mathematics classes.

Finally, we believe that this assignment type - like the one carried out with data from the region students live in -, be it based (or not) on the use of technologies (podcasts, in our case), can be a way to provide quality education to students, based on both critical reflection and access to information. Moreover, it can also be used as politicization strategy to enable these students to mobilize resistance to this capitalist logic, as well as to help changing the reality of these students, even if it happens in a micro universe.

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