Article

Access to education promoting sustainable mobility in cities

O acesso à educação promovendo uma mobilidade sustentável nas cidades

El acceso a la educación promoviendo una movilidad sustentable en las ciudades

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ABSTRACT

It is through education that the human being develops, leaves the state of alienation, and becomes capable of self-reflection. Despite being a right guaranteed by the Brazilian 1988 Constitution, accessibility to education still faces great challenges. Therefore, it is the object of study of this article, which relied on data from the Sustainable Development Index of Cities (IDSC-BR), focusing on Sustainable Development Goal 4 on quality education, in association with the Access to Opportunities Project, focused on access on foot, emphasizing the Early Childhood, Elementary and High School service in 15 Brazilian capitals. Thus, this research shows that inequality of access, according to income and color/race, was higher in Belém, Campo Grande and Porto Alegre. The capital Belém presented the worst indexes in the analysis.

Keywords: Active Mode of Transport. Pedestrian. Accessibility. Access Opportunities.

RESUMO

É por meio da educação que o ser humano se desenvolve, sai do estado de alienação e se torna capacitado para a autorreflexão. Apesar de ser um direito garantido pela Constituição de 1988, a acessibilidade à educação ainda enfrenta grandes desafios. Por isso, torna-se objeto de estudo deste artigo, e para isso foram utilizados dados do Índice de Desenvolvimento Sustentável das Cidades (IDSC-BR), com foco no Objetivo de Desenvolvimento Sustentável 4 sobre educação de qualidade, em associação com o Projeto Acesso a Oportunidades, com foco no acesso a pé, enfatizando a oferta de Educação Infantil, Fundamental e Ensino Médio em 15 capitais brasileiras. Dessa forma, esta pesquisa revela que a desigualdade de acesso, de acordo com a renda e com a cor/raça, foi maior em Belém, Campo Grande e Porto Alegre. A capital Belém apresentou os piores índices da análise.

Palavras-chave: Modo Ativo de Transporte. Pedestre. Acessibilidade. Oportunidades de Acesso.

RESUMEN

Es a través de la educación que el ser humano se desarrolla, sale del estado de alienación, se vuelve capaz de autorreflexión y, a pesar de ser un derecho garantizado por la constitución de 1988, la

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accesibilidad a la educación aún enfrenta grandes desafíos por superar. Por lo tanto, la accesibilidad a la educación se convierte en el objeto de estudio de este artículo, y para ello, los datos del Índice de Desarrollo Sostenible de las Ciudades (IDSC-BR), con foco en el Objetivo de Desarrollo Sostenible 4 sobre educación de calidad, en composición con el Proyecto Acceso a Oportunidades con foco en el acceso a pie, con énfasis en el servicio de Primera Infancia, Enseñanza Básica y Media en quince capitales brasileñas. Así, esta investigación muestra que la desigualdad de acceso, según renta y color/raza, fue mayor en Belém, Campo Grande y Porto Alegre. La capital Belém presentó los peores índices en el análisis.

Palabras clave: Modo de Transporte Activo. Peatonal. Accesibilidad. Oportunidades de Acceso.

INTRODUCTION

It is through education that human beings develop, become aware of their being, their attitudes, move away from a state of alienation, and approach self-reflection. Education is provided for in the Brazilian Federal Constitution of 1988 (Brasil, 2017b) as one of the fundamental rights. Furthermore, according to the Constitution, education aims to stimulate the complete development of the individual, their capacity for citizenship, and their qualification for work. However, access to this right still faces various challenges.

Mobility is a prevalent issue in the Brazilian social context. The cities' urbanization, particularly more pronounced in the past few years, favors the increase in motorized individual transportation over pedestrian mobility or alternative modes of transportation in urban areas with large populations. The concept of sustainability emerged in the 1980s advocating the importance of ensuring that development meets the needs of access to education, health, work, leisure, social and economic well-being, among other needs of the present, without compromising future generations, as specified by Carvalho (2016b) and Freitas *et al*. (2015).

In this sense, the United Nations (ONU, 2017), through the 2030 Agenda, defined the Sustainable Development Goals (SDGs) which describe the main development challenges for humanity. They encompass social needs, education, health, social protection, employment opportunities, along with the promotion of environmental protection and the quest to make cities and communities sustainable, inclusive, safe, and resilient (ONU, 2017). In total, there are 17 SDGs that seek to ensure a sustainable, peaceful, prosperous, and equitable life for all, not only in the present but also in the future.

However, urban environments often favor motorized vehicles and disregard the fact that a large portion of the population uses walking to access daily activities. Walking not only benefits health but also encourages interaction, fosters interpersonal relationships, and enhances exploration and familiarity with the surrounding environment. Thus, a model advocated for sustainable mobility seeks to reduce the use of automobiles or the distance traveled by individuals. The goal is to change and improve the mode of transportation. Thus, active transportation is inserted into the context of reducing the use of automobiles or replacing them with other means such as walking and cycling (Villada and Portugal, 2015; Faria and Lima, 2016; Cruz and Paulino, 2019).

Active urban transportation is defined as modes of transportation that rely on human propulsion, that is, those in which the energy involved in performing work comes from the human body, such as walking and cycling. It is an alternative mode of transportation characterized by promoting quality of

life, as it relates to physical activity, sustainability, reducing the use of polluting transportation, and accessibility, as it has low or no cost when compared to other means. It is a mode of transportation directly impacted by urban infrastructure and public safety (Brasil, 2017a; Dias, 2020).

Urban transportation policies must ensure access to health and education services, cultural and leisure activities, as well as employment opportunities. The promotion of active transportation stems from recognizing the needs of the population, particularly those with low incomes, who often endure long and exhausting journeys on foot due to the unavailability of other transportation options or their financial constraints (Faria and Lima, 2016).

In this sense, in 2020, Pereira *et al.* published a portrait of inequalities in access to opportunities in various areas in the 20 largest Brazilian cities. This study was called the "Access to Opportunities Project" and it is the referential basis of this article precisely because it includes studies on modes of active transportation. The project presents population, socioeconomic, and location data for employment, health, and education services. Accessibility estimates analyze, among other things, modes of active transportation (walking and cycling) in 20 cities and public transportation for seven major cities in the country.

According to Pereira *et al*. (2020), the project combines data from administrative records, sample surveys, satellite imagery, and collaborative mapping to calculate levels of accessibility at high spatial resolution (approximately at the block level). These estimates are also disaggregated by socioeconomic groups, according to income level and color/race.

From this perspective, the central idea of this article is to emphasize the figure of the pedestrian in the issue of access inequality that affects urban mobility. Schools (childhood, elementary, and high school levels) were chosen here as the object of study because it is through education that more opportunities for improving the population's life are created. Thus, the objective of this study is to analyze the inequality in access to education in 15 capitals, based on the research by Pereira *et al.* (2020), developed by IPEA, using as a background the Sustainable Development Index of Cities — IDSC, which evaluates the implementation of the SDGs in Brazilian cities, particularly SDG 4 (Education), relating income and color/race variables to urban mobility access outcomes.

LITERATURE REVIEW

The intense urbanization of Brazilian cities has produced profound transformations in the territory, directly affecting educational, political, economic, social, cultural, and especially spatial sectors, as it has reallocated activities, goods, and services, which has made mobility and accessibility fundamental variables for quality of life in cities. These factors directly influence urban planning, that is, the way the city is designed, and the dynamics established within it, reflecting on the functioning and social relations of its population (Alves and Raia Junior, 2009; Faria and Lima, 2016). In this sense, it is essential to consider urban mobility and accessibility to alternative and sustainable means of transportation regarding the theme of education. The following section presents this relationship to understand the complexity of the topic discussed here.

ACCESS TO EDUCATION AND MOBILITY

It is possible to relate urban mobility to access to education, as understanding the factors that influence this access is fundamental, considering that it is through education that a country can become better in all respects, especially concerning social inclusion. It is through this means that opportunities for all are opened, advocated by public policies to ensure access to education (Brasil, 2012; Fernandes, 2014).

However, despite education in Brazil being a right established by the 1988 Constitution and recognized for the importance of individual emancipation, development, and professionalization,

access to it in the country is characterized by inequality and non-universal opportunities, determining factors in the destinies of Brazilian children and youth. It is perceived that individuals with lower education tend to have lower qualifications, poorly paid jobs, shorter lifespans, poorer health conditions, and a higher probability of engaging in criminal activities. Furthermore, they tend to minimize aspirations for life changes (Pieri, 2018; Vizin, 2019).

Although there have been constant advances in the universalization of education, ensuring access and permanence in school are the main challenges faced in recent decades. The obligation to expand the provision of education for all is not accompanied by investments that promote access maintenance. This fact is highlighted by Kuhn and Puhl (2016), who point out that the attendance rate for Early Childhood Education is 19% for children aged zero to three years, 75% for those aged four and five years, and 98% for those aged between six and 14 years. In view of this, to ensure inclusive, equitable, quality education that promotes learning opportunities for all, there is SDG 4, which seeks to sustain education as a public good, a common human right, and a basis for guaranteeing other rights.

In this sense, the lack of transportation, difficulty in accessing school, violence, child labor, and other social, economic, and cultural barriers prevent children and adolescents from having their right to continue studying and progressing assured, as well as completing their formal education. Among the factors are socio-economic barriers, as it is perceived that wealthier individuals have nearly twice as many years of education as the poorer ones.

Regarding the lack of transportation, there are no specific data on how this interferes with school dropout, for example. Therefore, indicators were created with the intention of evaluating various factors that influence the degree of learning among students, including the coverage of Early Childhood, Elementary, and High School Education services, dropout rates, funding for education, use of school transportation, school feeding, infrastructure and quality of education (CNM, 2017; ONU, 2017).

To guide political action consistent with sustainable objectives, the IDSC was created in Brazil, which would facilitate the monitoring of the SDGs at the local level. A report monitoring the implementation of the SDGs, which aims to be a useful and effective tool for public management and political action in Brazilian municipalities, is a priority for local governments, according to the results obtained. This document presents a set of indicators adapted to the priorities of Brazilian cities, totaling 88 indicators from national public and official sources (Fuller, 2021).

It is important to emphasize that this document provides data that serve as sources for the research presented here. These data allow for an evaluation of whether the accessibility challenges are exacerbated by the parameters assessed in the IDSC. In the document, 770 municipalities that make up the IDSC-BR are shown, evaluated through 88 indicators, with an interval between 0 and 100, where the obtained score presents in percentages the distance that a city needs to reach optimal performance (Fuller, 2021). The target values were determined according to: a. absolute quantitative thresholds described in the SDGs and targets; b. in the absence of a clear target, universal access or zero deprivation (example: coverage of public services, upper limit = 100); c. goals based on scientific studies; d.for other indicators, the average of municipalities with the best performance regarding the overall score was used (Fuller, 2021).

To evaluate SDG 4, there are a total of 21 indicators in IDSC-BR, presented according to quantitative thresholds and target values, and the scores were calculated using the arithmetic mean. Four intervals were considered: when green is used, this means that the objectives of SDG were achieved; yellow means that there are still challenges to be overcome; orange means that there are substantial challenges; and, finally, red means that there are significant (big) challenges to be overcome. Among the indicators are early, elementary, and high school

education, which were evaluated concerning the calculation of the rate[1] between the number of students and teachers, providing a ratio that refers to "the lower, the better in relation to the proximity to achieving the goal". This indicates the availability of teachers in relation to the number of students in the analyzed city, which may reflect the number of schools available to the population (Fuller, 2021).

The Access to Opportunities Project, started in 2019, aims to annually stimulate the population's access to employment opportunities, health services, and education, by means of transportation, in the largest urban centers in the country (Pereira *et al*., 2020). In addition, it aims to create an open database on the accessibility conditions in Brazilian cities. The analyzed database is available on the project's virtual page, at https://www.ipea.gov.br/acessooportunidades/mapa/.

This project provides data on the inequality of access to employment, education, and health in the 20 largest Brazilian cities, according to public transportation mode: walking, or cycling. It also provides a categorical analysis by income and color/race and brings the possibility of mapping simulations and the portrait and estimate of accessibility through data from administrative records, sample surveys, satellite images, and collaborative mapping, to guide the planning and evaluation of public policies that promote sustainable and inclusive cities (Pereira *et al*., 2020).

Two types of accessibility indicators are calculated: the first is the minimum time to access the nearest opportunity, and the second presents the total number of opportunities that can be accessed in different time intervals. The project also presents the difference in access to school, according to the income group, where the Palma Ratio indicator was used, which is an index. This index is the ratio between the incomes of the wealthiest 10% over the poorest 40%. Thus, it can be more compassionate to the extremes of income distribution than the Gini index, for example, which simply points out the difference between the incomes of the poorest and the wealthiest. A Palma Ratio equal to 9 means that the accessibility of the wealthiest 10% is nine times greater than that of all the poorest 40%.

Similarly, an analysis was carried out to assess the inequality between the white and black populations, through the calculation of the quotient between the accessibility of these groups. Thus, a quotient greater than 1 means that whites have more access to opportunities than blacks (Pereira *et al.*, 2020).

MOBILITY AND ACCESSIBILITY

The urban planning process can directly interfere with access to opportunities[2] for study, health, work, leisure, social and economic well-being or lack of such access. The absence of accessibility to basic urban services, such as sanitation, water, health, education, transportation, and information, can lead to disastrous consequences such as marginalization, poverty, deprivation, and exclusion of a part of the population (ONU, 2016).

In this sense, Carvalho (2016a) explains that urban growth and mobility affect the shape of cities, fundamentally reflecting on social inequalities. The low-income population concentrates in the peripheries, places that are often deprived of urban infrastructure. This reality is responsible for these people's high dependence on public transportation to access jobs and various services

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1   Rate is defined as "the relationship between two values of the same quantity, generally expressed as 'a' to 'b', a:b or a/b, and sometimes represented arithmetically as a dimensionless quotient of the two quantities that explicitly indicates how many times the first number contains the second". (Available at https://pt.wikipedia.org/wiki/Raz%C3%A3o_(matem%C3%A1tica). Access on: September 19, 2021).

2   In this study, when the term 'opportunities' is used, it refers to opportunities for study, health, employment, leisure, social and economic well-being, as well as access to public and private services, and consumer goods.

in cities, even as they face high prices for services and products and long distances between their residences and various urban locations. Consequently, many peripheries become dormitory cities (which residents only use for accommodation, while working and conducting economic activities elsewhere).

Mobility, on the other hand, concerns the ease of movement of people, goods, and services through vehicles, roads, sidewalks, and others. It is also the result of the interaction between people's movements and goods with the city in daily life, constituting a preponderant factor that directly influences society. People move and depend on urban mobility to integrate economic and social issues of the community. A good mobility plan should benefit the population not only in locomotion but also in well-being and life quality (Paula and Leonardelli, 2015).

The collective promotion of accessibility is beneficial to the entire society and, if socially incorporated, allows inclusive and sustainable urban development for all, enabling the full enjoyment of social, cultural, economic, and political rights. Structurally stable transportation services, with good urban policies and plans, move towards social equity. A well-designed city is designed for everyone and values mobility and accessibility, both parameters for sustainable and democratic urban development (ONU, 2016).

Accessibility allows equal opportunity for everyone, regardless of their abilities, culture, or place of residence, as it allows exercising activities that integrate social or individual development, being fundamental for the socio-economic and cultural development of a city or region. It is not only about eliminating physical barriers that limit individuals' access but also about equalizing opportunities for access to study, health, work, leisure, social and economic well-being consistent with the population (Alves and Raia Junior, 2009; Teixeira, 2014).

Therefore, urban planning to guarantee mobility and accessibility must consider enterprises, services, and the distribution of economic activities in the territory, as it is natural for the occupation of areas closer to jobs and opportunities. Thus, it is necessary to stimulate the economic and social development of the most peripheral areas Carvalho (2016a).

Therefore, a city with deficient accessibility and mobility promotes social exclusion, as peripheral groups have restricted access to these opportunities, remaining in the vicious cycle of poverty. In this sense, analyses and interventions in sustainable urban mobility that evaluate people and regions with a disadvantage of access to different goods and services are essential, according to Freitas *et al.* (2015).

SUSTAINABLE DEVELOPMENT GOALS AND SUSTAINABLE URBAN MOBILITY

Sustainable development aims to consider the needs of present generations without compromising the ability of future generations to develop, in the same way that it is seen as a set of actions that satisfy human needs without violating the long-term regeneration capacity of natural resources. For this reason, territorial organization must be democratic, integrated, functional, and prospective, as well as, according to Teixeira (2014), it must value equality, equity, public interest, freedom, responsibility, and sustainability.

The UN, with the aim of achieving this purpose, held, in 2015, a general assembly, in which an ambitious and universal program was presented and adopted to transform the world, called Agenda 2030. It is consolidated by 17 SDGs that are universal, transformative, inclusive, and describe the main development challenges. The purpose is to ensure humanity's survival, with restricted use of natural resources, eradication of poverty, and other systemic barriers such as inequality, unsustainable consumption patterns, among others (ONU, 2017). There are a total of 169 objectives to be achieved, related to five areas of importance: people, prosperity, peace, partnerships, and the planet, as represented in Figure 1.

Figure 1 – Sustainable Development Goals.

Source: ONU (2021).

Although inclusive, safe, resilient, and sustainable cities as advocated by the United Nations face challenges generated by large metropolises, in the environmental area, transportation was responsible for emitting 204 million tons of greenhouse gases in 2016 alone. However, this does not only concern transportation itself, but all sectors and actors of urban life, encompassing the development of individuals and society in an inclusive manner, since mobility is related to lifestyle, and its transformation depends on the active participation of individuals (Villada and Portugal, 2015; Cruz and Paulino, 2019).

It is essential to understand that urban mobility directly influences the achievement of various goals, such as SDG 11, which proposes the promotion of inclusive, safe, and resilient cities and human settlements; and SDG 13, in which the replacement of motorized means of transportation reduces the emission of polluting gases that impact climate change. Additionally, mobility is directly related to people's life quality, access to health (SDG 3) and education (SDG 4), and decent work (SDG 8), besides reflecting on the reduction of inequalities (SDG 10) — goals proposed by the UN in 2017.

In this sense, the National Urban Mobility Policy brings the concept of sustainability, which is related to the use of public transportation. The sustainable agenda presents goals such as reducing the number of motorized trips, reviewing urban design and vehicle circulation, developing non-motorized means of transportation, and valuing pedestrians, among others.

In this scenario, walking becomes increasingly important and demands routes with sidewalks and streets that are safe and pleasant for everyone. In other words, mobility enables movement and circulation, and accessibility enables access to public and private spaces in cities. Both provide an equitable space for the population (Alves and Raia Junior, 2009).

MATERIALS AND METHODS

In this article, quantitative and qualitative methods and descriptive analysis were used to conduct the intersection and analysis of available data from the Mapping of Access to Opportunities in Brazilian Cities 2019 (Pereira *et al.,* 2020), with the IDSC-BR from the UN, in 15 Brazilian capitals in the Early Childhood, Elementary, and High School Education, relating income and race/color.

The inclusion criteria for the analysis of these data were: being a Brazilian capital city, and the data being available in the IDSC-BR. Five cities analyzed in the Access to Opportunities Project were excluded because they did not have their data available on both platforms simultaneously. The data collection considered capital city data to facilitate the construction of maps and to present a specific scope. These data are presented in Table 1.

Table 1 – Capitals of Brazil included in this study.

Capitals of Brazil		
Belém	Goiânia	Recife
Belo Horizonte	Maceió	Rio de Janeiro
Campo Grande	Manaus	Salvador
Curitiba	Natal	São Luís
Fortaleza	Porto Alegre	São Paulo

Source: the authors (2021).

For data tabulation and analysis, the Microsoft Excel® software was used. For presenting the results, the QGIS® software, an open-source geographic information system, version 3.18.1, was used in conjunction with cartographic databases available on the IBGE platform. Microsoft Excel® was also used for creating georeferencing maps. The methodology presented in the flowchart available in Figure 2 was applied, showing the data sources on access to opportunities by walking and the IDSC, which presents education indicators based on the UN Sustainable Development Indices.

Figure 2 – Study Methodology.
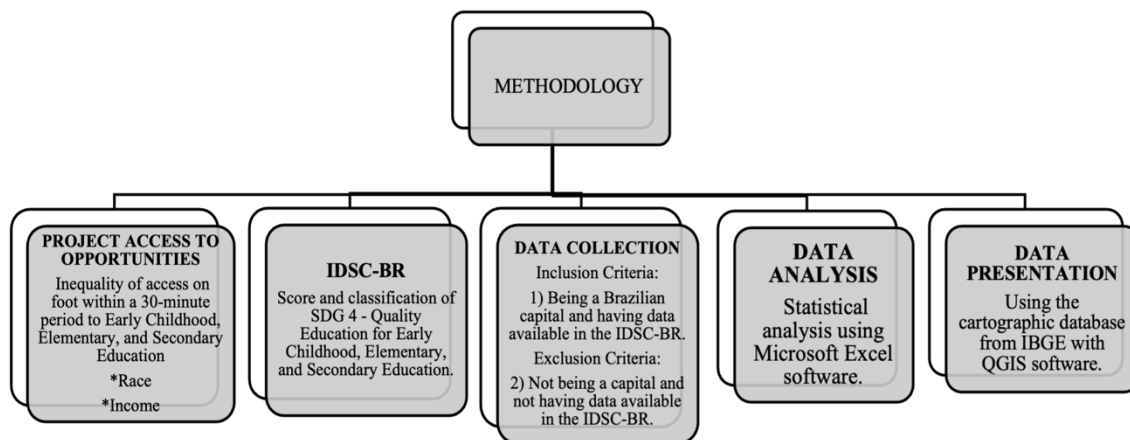
Source: the authors (2021).
SDG: Sustainable Development Goal; IDSC-BR: Sustainable Development Index of Cities of Brazil; IBGE: Brazilian Institute of Geography and Statistics.

It is worth noting that the Pereira Project, entitled "Access to Opportunities", from Pereira *et al.* (2020), is the elementary source for this article. For this study, data on inequality of access to Early Childhood, Elementary, and High School Education were collected, considering the calculation of inequality ratio by income and by race/color. From the available data from the IDSC-BR, the overall score and ranking, as well as SDG 4 — Quality Education, were collected to analyze if there is a relationship between greater inequality of access to education and worse indicators related to SDGs. The indicator evaluated in SDG 4 informs the quotient between the number of students and the number of teachers for each educational level.

DATA ANALYSIS AND RESULTS OBTAINED

The collected data were presented according to the inequality of access by income and race/color, as well as the level of education. Each table exposes the classification of IDSC-BR according to the score obtained in the type of study, such as the grade in the indicators of Early Childhood, Elementary, and High School Education.

Table 2 presents the collected data of the inequality ratio according to income for access to Early Childhood, Elementary, and High School Education, considering the 30-minute time required for commuting to the nearest school, available on the platform. The data are provided according to the Palma Ratio, where the average accessibility of the top 10% richest of the population is calculated against the accessibility of the bottom 40% poorest, and are ordered by cities with the best SDG indicators.

Table 2 – Income-based access inequality (Palma Ratio).

Capital	Classification IDSC-BR	Early Childhood Education	Elementary School	High School
Curitiba	30	0.1	0.8	1.6
São Paulo	48	0.4	0.4	0.5
Goiânia	111	0.5	0.8	1.1
Belo Horizonte	133	0.4	0.9	1.4
Campo Grande	225	0.6	1.2	2.4
Porto Alegre	252	0.4	1.3	3
Manaus	260	0.5	0.6	1
Rio de Janeiro	270	0.6	0.8	1.1
Salvador	357	0.5	0.5	0.7
Recife	378	0.5	0.5	1.2
Fortaleza	460	0.3	0.4	0.8
Natal	500	0.4	0.8	1.9
Maceió	536	0.4	0.7	0.9
São Luís	556	0.4	0.7	0.7
Belém	635	1.2	1.9	3.4

Source: the authors (2021). Data collected from IDSC-BR and SDG 4 of the capitals.

The best-ranked capital among those analyzed by the Access to Opportunities Project was Curitiba/PR, occupying the 30th position. The worst was Belém/PA in the 635th position, noting that the IDSC-BR collected data from 770 cities. According to the Palma ratio, high school shows the highest accessibility for the top 10% in comparison to the bottom 40%. In Early Childhood Education, the difference is identified only in the capital Belém, and, in Elementary Education, in Campo Grande, Porto Alegre, and Belém.

In Table 3, the calculation of the inequality ratio regarding access to Early Childhood, Elementary, and High School is presented according to race/ethnicity, considering the time of 30 minutes required to commute to the nearest school, through the access quotient.

In relation to race/ethnicity, the highlight of inequality of access to high school persisted in the capitals Belém, Campo Grande, and Porto Alegre. Regarding the analysis of the SDGs, indicators from SDG 4 were collected from the IDSC-BR and used to construct the maps shown in Figures 3, 4, and 5. Figure 3 presents the ratio between the number of students and teachers in Early Childhood Education (2019). In the map, according to the color legend, the extent of goal achievement can be discerned.

Table 3 – Inequality of access according to race/ethnicity.

Capital	Classification IDSC-BR	Early Childhood Education	Elementary School	High School
Curitiba	30	0.7	1	1.1
São Paulo	48	0.8	0.9	0.9
Goiânia	111	1	1	1.1
Belo Horizonte	133	0.8	1	1.1
Campo Grande	225	0.9	1.1	1.2
Porto Alegre	252	0.8	1	1.4
Manaus	260	0.9	1	1
Rio de Janeiro	270	0.9	1	1.1
Salvador	357	0.8	0.8	0.9
Recife	378	0.9	0.9	1.1
Fortaleza	460	0.9	0.9	1
Natal	500	0.9	1	1.1
Maceió	536	0.9	1	1
São Luís	556	1	1	1
Belém	635	1	1.1	1.2

Source: the authors (2021). Data collected from IDSC-BR and SDG 4 of the capitals.

**Figure 3 – Indicator Sustainable Development Goal 4 — Early Childhood Education.**
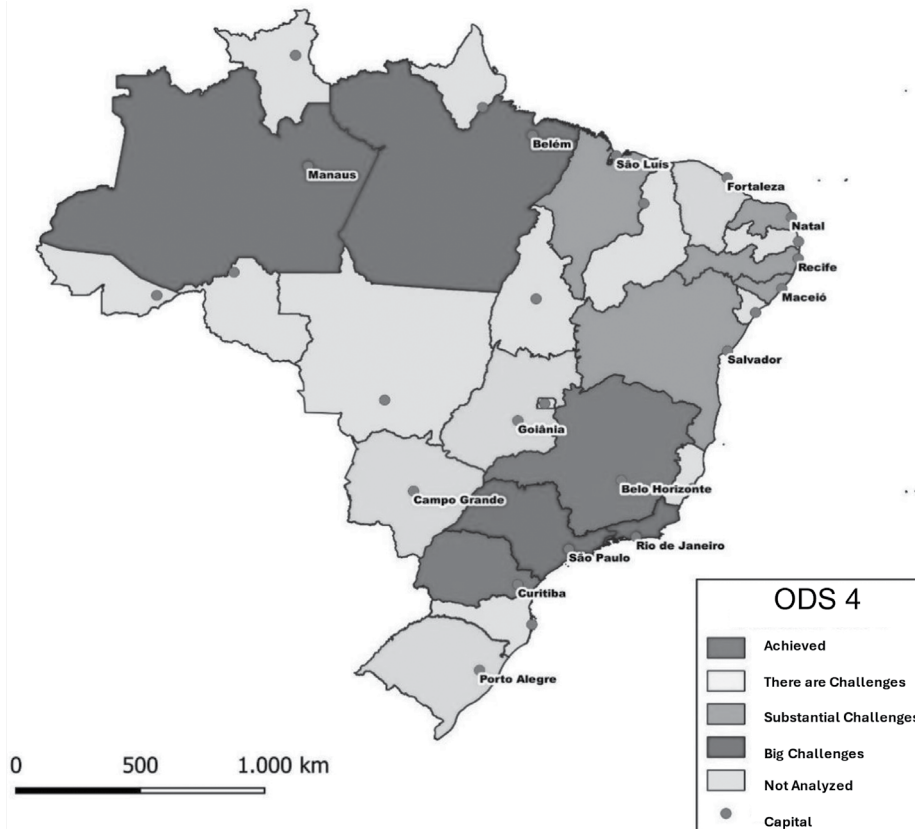
Source: the authors (2021), using QGIS software and the IBGE cartographic database.

Figure 4 – Indicator Sustainable Development Goal 4 — Elementary School.
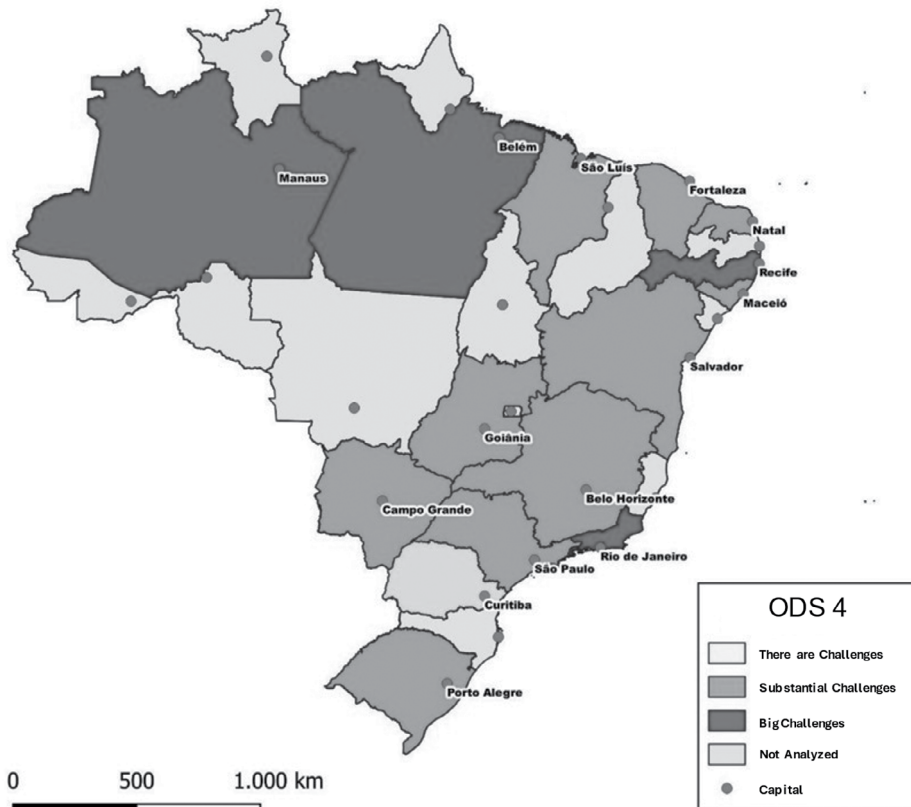
Source: the authors (2021), using QGIS software and the IBGE cartographic database.

Figure 5 – Indicator Sustainable Development Goal 4 — High School.
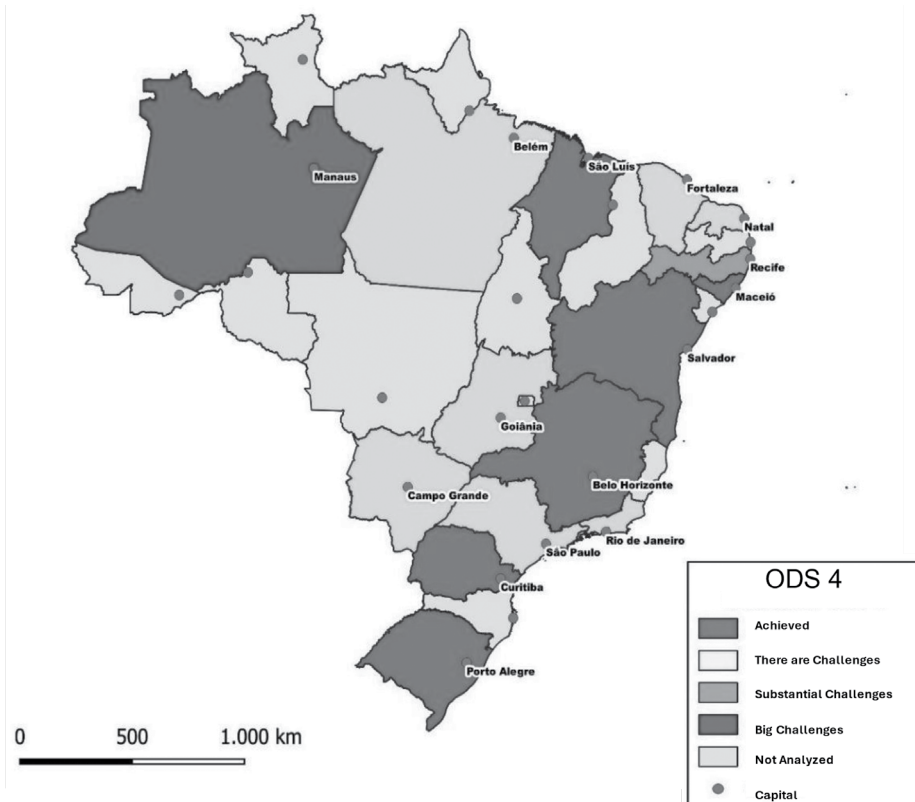
Source: the authors (2021), using QGIS software and the IBGE cartographic database.

In this figure, it is observed that most capitals face significant or substantial challenges, meaning they are far from achieving the SDGs. Similar to the results regarding differences in access to opportunities, the capital Belém faces significant challenges in preschool education, as do other cities such as Manaus, São Paulo, and Rio de Janeiro.

Following the same pattern as Figure 3, Figure 4 highlights the ratio between the number of students and teachers in Elementary Education. It's worth noting that, in this analysis, no capital included in the study achieved the SDG for Elementary Education. Furthermore, most capitals are far from reaching this goal.

In Figure 5, the classification of capitals regarding the ratio between the number of students and teachers in High School is presented according to IDSC-BR, with Manaus being the only capital facing significant challenges, and Recife having substantial challenges. Thus, most cities have achieved the SDGs or presented few challenges, contrasting with the results of access to opportunities, where High School Education shows the most inequality among the analyzed capitals, both concerning income and race.

In Table 4, there is a summary of the classification of SDG 4 for quality education, where the colors follow the meaning used in the legends of the maps, as presented earlier: green indicates that the capital has achieved the goal, yellow means there are still challenges to be overcome, orange indicates substantial challenges, and red represents the significant (big) challenges that the city faces in achieving the SDG 4 proposal.

Table 4 – Capitals of Brazil and Quality of Education.

Capitals of Brazil	Early Childhood Education	Elementary Education	High School
Belém			
Belo Horizonte			
Campo Grande			
Curitiba			
Fortaleza			
Goiânia			
Maceió			
Manaus			
Natal			
Porto Alegre			
Recife			
Rio de Janeiro			
Salvador			
São Luís			
São Paulo			

Light blue: achieved the SDG4 target. Intermediate blue: There are challenges to overcome. Dark blue: did not achieve the SDG4 target.
Source: the authors (2021).

It is observed that once again Belém is the capital facing significant challenges in Elementary and Early Childhood Education, along with Rio de Janeiro and Manaus. The best indices are only observed for Early Childhood Education in Belo Horizonte and Curitiba. Meanwhile, the Sustainable Development Goal (SDG) is achieved (green) most prominently in Belo Horizonte, Curitiba, Porto Alegre, Maceió, Salvador, and São Luís. It is worth noting that no city analyzed achieved SDG 4 for Elementary Education. In fact, looking at this table, education (SDG 4) is a major social issue to be addressed, and this likely reflects on urban mobility, as lower levels of education correlate with greater resistance to engagement in solving social problems by the population, as presented in Section 2 of this article.

DISCUSSION

The inequality in access to education is a constant issue in Brazil, stemming from historical social inequality. The reflection of income inequality in the country and access to education is evident in the indices revealing that the poorest 10% have, on average, 7.6 years of schooling, while the richest 10% have 13.7 years, almost double (Pieri, 2018). In the analysis presented here with the income variable, it is demonstrated that this variable has a greater impact on pedestrian access to Early Childhood, Elementary, and High School Education.

The capital Belém, despite having a good availability of schools for the population, presents the worst indices among the analyzed capitals, with its Elementary School units performing better than its Early Childhood Schools (Pereira *et al.,* 2020). The underfunding of Elementary Education networks at the expense of Early Childhood Education is, according to Ferreira (2019), a justification for this disparity, as, in his analysis, the resources allocated to this modality are insufficient in the country, resulting in only 26% of low-income children attending daycare, compared to 55% of the wealthiest (Cruz and Monteiro, 2019). The gap in Early Childhood Education is concerning, since starting formal education earlier leads to more effective learning. Furthermore, the lack of access to this education is directly related to the perpetuation of social inequality (Fernandes, 2014; Pieri, 2018). And all of this, obviously, reflects on urban mobility.

Early Childhood Education has recently received due attention in our country. The modality is slowly expanding, as evidenced by the low number of Brazilian municipalities considerably distant from universalization. Between 2000 and 2010, despite the growth in vacancies, there was a concentration of these in certain regions, representing the intrinsic need for displacement with considerable distances from neighboring regions, limiting access for peripheral populations (Baggio, Barros and Freitas Junior, 2021). Despite public policies for expansion such as the National Education Policy, according to Freitas (2019), out of the 17 strategies elaborated, only eight are being implemented, further distancing the achievement of the goal of universalizing Early Childhood Education by 2024.

In the capital Belo Horizonte, concerning Early Childhood Education, 96% of 4 and 5-year-old children in the metropolitan region are in preschool, and, as presented, the city achieved the SDG goal (Cruz and Monteiro, 2019). It has an urban mobility plan aimed at promoting active modes of transportation, with improvements in sidewalks and crossings, by means of the projects called "BH on Foot" and "Pedal BH" (Belo Horizonte, 2017). Thus, it is possible to observe the cruciality of an urban structure that promotes mobility and accessibility, as this is directly related to access to opportunities and school attendance, according to Sena, Jardim Filho, and Pietrafesa (2019).

Urbanization is directly related to the increase in the proportion of children in daycare and preschool (Baggio, Barros and Freitas Junior, 2021). Incentivizing active mobility promotes

universal accessibility, increases access to public spaces equitably, in health, education and work, in addition to improving environmental, social, and economic conditions (VW, 2021).

Despite the Ministry of Education having a school transportation program to ensure access and attendance of students in institutions, it is primarily intended for Elementary School students residing in rural areas. Furthermore, in many routes, there are no conditions for boarding and disembarking from school vehicles, which also do not have ideal traffic conditions. Therefore, the need for incentive programs and urban planning is emphasized, considering that there are students who travel up to 12 kilometers to get to school (Brasil, 2017b).

According to Cruz and Monteiro (2019), the inequality of access by race/color is 12 percentage points for High School, and, for income, there is a difference of 33.8 points. In line with the results obtained, for High School, there is the highest number of capitals with inequality of access between rich and poor, and blacks and whites. High School Education is another fundamental factor in the structural change of Brazilian reality since, economically, an individual with High School Education earns a salary 32% higher than one with only Elementary Education. This percentage rises to 230% if the individual is graduated, argues Pieri (2018).

FINAL CONSIDERATIONS

Considering the purpose of this work in analyzing education and its relationship with urban mobility, it was possible to identify a correlation between infrastructure and population access to education, as well as to leisure and health.

The disorderly urban growth of Brazilian capitals has created an environment of service concentration, including educational services. The historical inequality of society has been further intensified by the absence of urban planning with equality and equity. The differences in social, economic, and racial/color strata are manifested in the daily lives of large urban centers, presenting a significant contrast with peripheral regions.

Access to institutions and services, both public and private, related to urban planning, mobility, and accessibility, directly impacts socio-spatial inequalities. Education is a transformative instrument of society, a constitutional right of every Brazilian. However, there are several obstacles to the realization and maintenance of education, mainly the lack of public policies aimed at this area. The urban model for cars often excludes pedestrians, meaning it is a project that considers only a small portion of society.

Thus, the project aimed at providing access to opportunities for services and goods, while considering environmentally beneficial modes of transportation, questions the socio-spatial distribution of public institutions, highlighting the inequality that manifests in cities. Inequality of access is observed to be related to the achievement of SDGs, but there is a need to further study and establish a concrete relationship with more factors.

The inequality of access due to income was considerably greater than the inequality due to race/color, with high school education being the most affected by this disparity. The capital Belém presented the worst analyzed indices; however, cities with a good position in the IDSC-BR exhibit similar Palm Ratios.

With everything presented here, although in a broad manner and needing further studies in the area, it is important to emphasize the need to reformulate urban infrastructure, focusing on pedestrians and considering the social function of transportation, especially active transportation, to better promote access to major cities.

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