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Basic education and sustainability: an exploratory analysis of training for sustainable transport habits

Educação básica e sustentabilidade: uma análise exploratória da formação para hábitos de transporte sustentável

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ABSTRACT
Through an exploratory literature review, this article discusses the need to promote sustainable transport habits in schools, given the increasing environmental degradation and high carbon emissions from the transport sector. While there are several strategies to promote sustainable transport, the effectiveness of these interventions depends on behavioral changes. The discussions are based on the searches conducted, including a bibliometric analysis and a narrative analysis. The searches introduce the concepts of 'education on sustainable transport' and 'education and sustainable development – ESD' within the Brazilian context. Regarding the theme, the bibliometric analysis highlights: suitable journals for the publication of future studies; the multidisciplinary nature of the subject; and the scarcity of studies. The narrative analysis suggests three hypotheses for future studies: the relationship between the scarcity of studies and the lower need for child awareness in developed countries; the positive impact of a solid foundation of environmental awareness in the school curriculum; and the inadequacy of current educational practices in Brazilian schools. However, the article provides insights into how educational practices can promote sustainable transport habits from childhood.

RESUMO
Por meio de uma revisão de literatura exploratória, este artigo discute a necessidade de promover hábitos sustentáveis de transporte nas escolas, dada a crescente degradação ambiental e as altas emissões de carbono pelo setor de transportes. Embora existam várias estratégias para promover o transporte sustentável, a eficácia dessas intervenções depende de mudanças comportamentais. As discussões são pautadas nas buscas realizadas, em uma análise bibliométrica e outra de narrativas. As buscas inserem no âmbito brasileiro os conceitos de "educação sobre transporte sustentável" e "educação e desenvolvimento sustentável - EDS". Com relação à temática, a análise bibliométrica destaca: periódicos adequados para a publicação de estudos futuros; o caráter multidisciplinar; e a escassez de estudos. A análise de narrativas sugere três hipóteses para futuros estudos: a relação entre a escassez de estudos e a menor necessidade de conscientização infantil em países desenvolvidos; o impacto positivo de uma base sólida de conscientização ambiental no currículo escolar; e a insuficiência das práticas educacionais atuais nas escolas brasileiras. Contudo, o artigo oferece insights para que práticas educacionais promovam hábitos de transporte sustentáveis desde a infância.

1. INTRODUCTION

Planet Earth is experiencing unprecedented levels of environmental degradation and encouraging more sustainable habits is urgent (Ienna et al., 2022). The transport sector is responsible for 23% of global

carbon emissions, the second highest after electricity and heat production. Thus, travel by more sustainable modes is an effective way to reduce emissions (Zhao et al., 2023), especially in a context in which society is increasingly mobile and, consequently, more motorized (Rogelj et al., 2024).

It is a consensus within the field of transport research that to promote sustainable transport, it is essential to invest in public and active transport (Ahmad and Oliveira, 2016; Fisher et al., 2017; Ramirez-Rubio et al., 2019; Bonsu et al., 2020), so that it is feasible to reduce the use of individual motorized transport, modifying the displacement matrix. Several strategies are proposed in this direction. Manage (Ahmad and Oliveira, 2016; Mohammed et al., 2016; Bibri, 2020; Yang et al., 2020) and regulatory (Jiménez et al., 2020; Yang et al., 2020) parking lots; and levy taxes on the ownership and use of automobiles (Ahmad and Oliveira, 2016; Jiménez et al., 2020), for example, are strategies that can subsidize improvements in public transport, integrating it with active transport (Stankov et al., 2020; Pakdeewanich et al., 2020), while restricting the use of the automobile.

The problem is not the proposition of strategies and solutions, these exist in abundance in the literature and many cities, including Brazilian ones, have been implementing them. The study by Amorim (2022) corroborates this statement by listing 106 mentions related to ways in which the transport sector can contribute to the sustainable development of cities and regions, based on a review of 65 articles. However, what is perceived is that no strategy makes sense without encouraging mutual respect and building a shared mentality among users of the various modes of transport (Malik et al., 2020; Bonsu et al., 2020; Zellmer, 2020). Sacramento et al. (2023) add that only through mutual collaboration and continuous investment in education will it be possible to achieve a society in which the right to come and go is guaranteed, without sacrificing security and human dignity.

On the one hand, the high rates of vehicular congestion, occupying most of the road space, associated with the lack of specific infrastructure for active transport, discourage the use of this mode; on the other hand, public transport is financially unsustainable (Loo et al., 2018). In this regard, the authors argue that although the transport system is crucial in a developing country, its inefficiency can lead to negative impacts, such as environmental degradation, mismanagement of public funds, health and safety concerns, and social inequalities. Therefore, the priority still given to individual motor vehicles is a warning factor, which must be addressed immediately (Scheffer et al., 2019).

As more people transition from using individual vehicles to alternative modes of transport, per capita emissions are reduced, which in turn improves both environmental quality and community health (Mohammed et al., 2016). Therefore, in addition to any interventions within the transport sector, education is crucial in influencing public behavior and reducing the use of polluting vehicles. Kitamura et al. (2018) emphasize the importance of implementing the 'three Es' (Engineering, Enforcement, and Education) in developing countries. The authors specifically highlight that the role of education in raising public awareness is often overlooked compared to the other two dimensions. Consistent educational programs must be implemented from an early age (Loo et al., 2018). It is through social awareness that the educational process will lead to behavioral changes (Loo et al., 2018; Jamroz et al., 2019). To create more sustainable cities, sustainable transport is essential—not only to reduce environmental and economic impacts but also to address social inequalities and improve road safety during these trips.

Serra do Ramalho (2020) emphasizes that, often due to a lack of information, people do not give sufficient importance to awareness policies. The document further states that children play a crucial role in this process, and therefore, traffic education must begin in the classroom, as 'the school plays an important role in collaborating and implementing actions that can strengthen learning and reflection on traffic education from early childhood education' (Serra do Ramalho, 2020). Additionally, Flogia et al. (2024) argue that environmental education should be effectively

implemented during childhood. In this regard, Sá (2021) adds that the school has a significant role in developing each individual's ecological awareness, and that, furthermore, care for life should be encouraged from early childhood education. Therefore, children represent a critical population group, as habits are passed down through generations (Rogelj et al., 2024). If they learn to use sustainable modes of transportation, such as walking, cycling, and public transport, they are more likely to carry these behaviors and habits into adulthood (Hopkins et al., 2021; Dütschke et al., 2022; Biondi et al., 2022) and pass them on to future generations (Rogelj et al., 2024).

That said, the question guiding the development of this scientific article is: Does basic education address the formation of more sustainable transport habits? Aiming to answer this question, this paper seeks to investigate recent literature, both Brazilian and international, and formulate hypotheses to guide future research. To achieve this objective, the article relies on an exploratory literature review, focusing on a bibliometric analysis and a narrative analysis. The specific objectives are, based on the bibliometric analysis: to understand the recent academic landscape regarding the relationship between sustainable transport habits and basic education; and, through the narrative analysis: to identify research gaps, both at the Brazilian and international levels.

To answer the question and achieve the proposed objectives, this article is structured into four sections, in addition to the introduction. Section 2 outlines the proposed methodology for the exploratory analysis. Section 3 presents the discussions, divided into two parts: a bibliometric analysis and a narrative analysis. Finally, Section 4 is dedicated to the concluding remarks.

2. METHODOLOGY

The exploratory review was based on a continuous and iterative process, where the selection of initial references should incorporate new keywords to enhance the search. As shown in Figure 1, three rounds of searches were conducted. Three platforms were used in the three rounds: one for both Brazilian and international searches (Google Scholar); one solely for Brazilian searches [Dissertations and Theses Catalog (CAPES)], aimed at identifying whether the topic is being addressed within Brazilian postgraduate studies; and the last one solely for international searches (SCOPUS). Furthermore, it is important to note that, in order to identify what has been studied recently, this review is limited to works published from 2020 until the completion of this article (April 2024).

The searches resulted in a total of 3,937 works, of which only two were from the CAPES Dissertations and Theses Catalog, twenty from the SCOPUS database, and the remaining 3,915 from Google Scholar. Since Google Scholar yields a wide range of works, it was decided that only articles published in journals would be selected from this platform, preferably those indexed in the A-level category of the CAPES Sucupira platform. This approach follows the rationale that the most significant contributions are likely to be found in leading journals (Webster and Watson, 2002).

Initially, the focus was on searching for results related to activities in basic education concerning traffic education. Although the emphasis was on issues related to sustainable transport, this keyword was not used in the first round. A preliminary search revealed that its association with the other selected keywords mainly led to studies on alternative transport for home-to-school trips. From the reading of titles, keywords, and abstracts, thirty works were selected for the literature review out of the 3,774 results from this round of searches, as they had the potential to contribute to the topic at hand. It is noteworthy that only one work (Poimenidis and Papavasileiou, 2021) specifically addresses the association between basic education and training for sustainable transport habits. This was the result of the search using the combination of the keywords 'traffic education' and 'primary schools', highlighted in red in Figure 1.

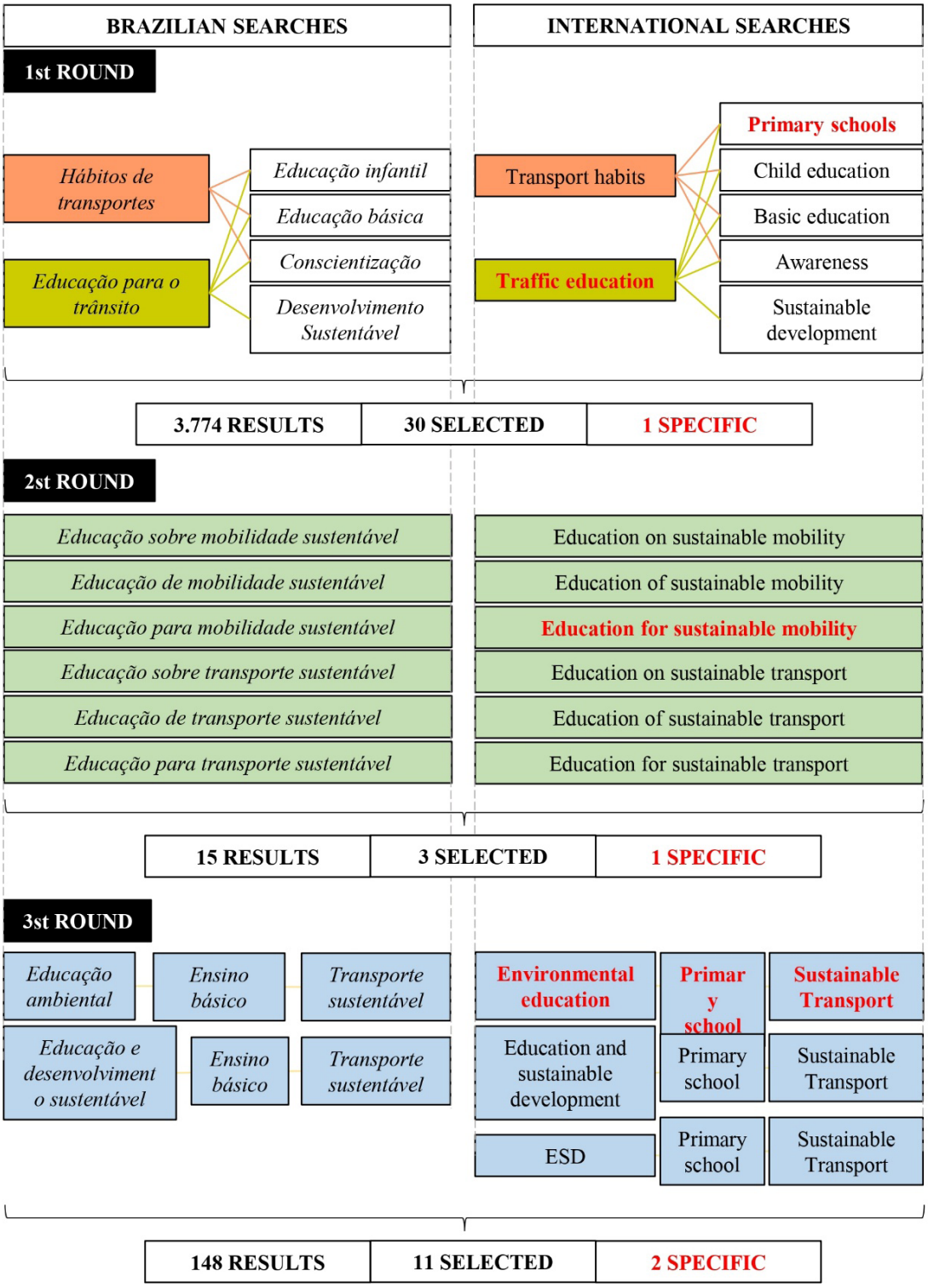

Figure 1. Keywords used in exploratory research.

From this 1st round, the concept of 'education on sustainable mobility' emerged, as discussed in the research conducted by Rogelj et al. (2024). Thus, in the 2nd round, this concept was incorporated. Since it is a keyword that involves education and sustainable transport through the concept of sustainable mobility, there was no need to associate it with other keywords. The

search was enhanced with 'of' and 'for' instead of 'on', and with 'transport' instead of 'mobility'. The same keywords were translated for searches conducted in Portuguese. Using the same logic as in the first round, of the fifteen resulting articles, three were selected, and only one specifically addressed the theme of the association between basic education and training for sustainable transport habits, the work by Benčina et al. (2022), resulting from the search for the keyword: 'education for sustainable mobility' (highlighted in red in Figure 1).

In the analysis of the second round, the keyword 'environmental education' emerged prominently. Associated with this, the opportunity arose to include 'sustainable transport' as a keyword in the third round. To include the school level, 'primary school' was used, as it had been one of the highlights in the first round. Furthermore, the term 'education' was already included in 'environmental education', and for this reason, in the Portuguese search, *'ensino básico' was used instead of 'educação básica' as the translation for 'primary school'. Within this same round, the concept of 'Education and Sustainable Development – ESD' emerged, addressed in the study by* Piscová et al. (2023). Thus, two additional combinations were created for the international search and one for the Brazilian search. This last round resulted in 148 works, of which eleven were selected, and two specifically addressed the theme of the association between basic education and training for sustainable transport habits (Humberto et al., 2021; Rogelj et al., 2024), both resulting from the combination of the keywords: 'Environmental education', 'Primary school', and 'Sustainable transport' (highlighted in red in Figure 1).

3. DISCUSSIONS

This section is divided into two parts. The first part presents a brief bibliometric analysis to contribute to the development of research on the topic addressed in this article. This analysis provides a deeper understanding of the recent academic landscape, evaluating the quality and impact of publications, identifying potential journals for future studies, and highlighting key areas and main perspectives. In the second part, the selected works are discussed in detail, offering a narrative analysis aimed at identifying research gaps, both within Brazil (nationally) and internationally, on the topic.

3.1. Bibliometric analysis

Table 1 presents the 42 studies reviewed, after excluding duplicates, and categorizes the 41 articles by journal, providing details on their classification and the corresponding academic area (CAPES). The journal with the highest number of selected articles (13) was *Sustainability, followed by the Journal of Transport & Health with three articles. The Journal of Transport Geography, Transportation Research Part F, Safety Science, and Case Studies on Transport Policy each published two articles. Among these, the Journal of Transport Geography stands out as it features a study by* Humberto et al. (2021), one of the few publications directly addressing the theme of this study, and is also of national origin, specifically from Brazil. The articles (and dissertations) are derived from publications across eleven distinct academic areas, as shown in the final column of Table 1. This highlights the multidisciplinary nature of the theme explored in this article.

Table 2 classifies the reviewed works by their addressed themes as follows: eleven related to "behavior and environmental awareness," one related to "public opinion", nine related to "road safety", nine on the "promotion of sustainable transport", eight related to "environmental education", and four on "basic education and training for sustainable transport habits". Of the four studies focusing

on the same theme as this article (basic education and training for sustainable transport habits), two are non-indexed (Benčina et al., 2022; Poimenidis and Papavasileiou, 2021), one was published in an A2 journal in the field of *Geography (*Rogelj et al., 2024), and only one was published in an A1 journal in the field of Engineering I (Humberto et al., 2021). It is important to note that the Qualis ranking used is from the 2017-2020 period, the most recent available at the time of writing this article.

Regarding content, two studies are more focused on specific topics. One is centered on bicycle use (Poimenidis and Papavasileiou, 2021), while the other examines gamification strategies (Rogelj et al., 2024). Poimenidis and Papavasileiou (2021) assess students' knowledge, opinions, and intentions regarding the benefits of cycling, as well as the challenges to its widespread adoption as a mode of transport. Rogelj et al. (2024) explore whether gamified activities can influence students' travel habits and whether changes in these habits are affected by age. The other two studies are broader in scope and align more closely with the research focus of this article. Humberto et al. (2021), the only study conducted in Brazil, offers insights into the role of early childhood education and the behavioral changes of caregivers toward sustainable transportation. Finally, Benčina et al. (2022) focus on education and training for sustainable mobility in kindergartens and primary schools.

Based on the searches conducted, it is evident that this is a topic that remains underexplored, particularly at the Brazilian level. This is concerning, as the literature reviewed in subsection 3.2 highlights the importance of fostering sustainable habits from an early age.

Table 1: Articles (by journals) and dissertation used in the review.

Codes/Revised Jobs		Journals/Qualis Classification		Main Area (CAPES)
1	Antronico *et al*. (2020)	Sustainability	A2	Engineering I
2	Campisi *et al*. (2020)			
3	Chuvieco *et al*. (2021)			
4	Deluka-Tibljaš *et al*. (2021)			
5	Mateu and Sanz (2021)			
6	Niens *et al*. (2021)			
7	Cieśla and Macioszek (2022)			
8	Lopez-Carreiro *et al*. (2023)			
9	Wachnicka *et al*. (2023)			
10	Zhao *et al*. (2023)			
11	Lanzini *et al*. (2024)			
12	Ienna *et al*. (2022)			
13	Andreoni and Ruiz Vargas (2020)			
14	Bina *et al*. (2021)	Journal of Transport & Health	A2	Collective Health
15	Alonso *et al*. (2023)			
16	Agyeman and Cheng (2022)			
17	Frater and Kingham (2020)	Journal of Transport Geography	A1	Engineering I
18	Humberto *et al*. (2021)			
19	Barić *et al*. (2020)	Transportation Research Part F	A1	Engineering I
20	Salducco *et al*. (2022)			
21	Palmos *et al*. (2021)	Safety Science	A1	Engineering III
22	Thibenda *et al*. (2022)			
23	Podgorniak-Krzykacz and Trippner-Hrabi (2021)	Case Studies on Transport Policy	A2	Engineering I
24	Gunnarsdóttir *et al*. (2023)			

Table 1: Continued...

Codes/Revised Jobs		Journals/Qualis Classification		Main Area (CAPES)
25	Ordinez *et al*. (2021)	Transportation Research Part D	A1	Engineering I
26	Biondi *et al*. (2022)	Transportation Research Part A	A1	Engineering III
27	Dütschke *et al*. (2022)	Travel Behaviour and Society	A2	Engineering I
28	Dasoler and Gonçalves (2023)	Annals of the Brazilian Academy of Sciences	A2	Biodiversity
29	Barman (2023)	Journal of Survey in Fisheries Sciences	B3	Biodiversity
30	Díaz-López *et al*. (2023)	Environmental Development	A1	Environmental Sciences
31	Turoń *et al*. (2021)	Energies	A2	Engineering IV
32	Rogelj *et al*. (2024)	European Journal of Geography	A2	Geography
33	Apollo and Mbah (2021)	Climate	A2	Geography
34	Hopkins *et al*. (2021)	Transportation	A1	Urban and regional planning / Demography
35	Proctor *et al*. (2020)	Health and Place	A1	Collective Health
36	Silva *et al*. (2023)	Education Sciences	A2	Education
37	Benčina *et al*. (2022)	Journal of Contemporary Educational Studies	Not Indexed	
38	Zawieska and Archanowicz-Kudelska (2023)	Transportation Research Proceeded		
39	Poimenidis and Papavasileiou (2021)	Journal of Language and Education Policy		
40	Hong (2021)	Online *Journal* of Educational Policy and Management		
41	Piscová *et al*. (2023)	European Journal of Science and Mathematics Education		
42	Freire (2020)	Not Applicable (Dissertation)		Teaching

Table 2: Division of the reviewed papers by Theme addressed.

Theme addressed	Revised Labour Codes[1]
Behavior and environmental awareness	1; 3; 10; 12; 15; 16; 27; 34; 35; 36; 38
Public opinion	2
Road safety	4; 9; 14; 19; 20; 22; 28; 40; 42
Promoting sustainable transport	5; 7; 8; 17; 23; 24; 25; 26; 31
Environmental education	6; 11; 13; 21; 29; 30; 33; 41
Basic education and training for sustainable transport habits	18; 32; 37; 39

[1]As per Table 1.

3.2. Analysis of narratives

Wachnicka et al. (2023) state that in countries with well-developed educational systems and robust cycling infrastructures, young children are educated from an early age to deal with dangerous scenarios. Education and training are referred to as any program designed to increase knowledge of desired cycling skills or cycling laws to avoid conflicts with traffic and pedestrians

(Frater and Kingham, 2020; Mateu and Sanz, 2021). Therefore, especially in countries that do not possess these characteristics, it is necessary, in addition to infrastructure issues, to create better programs. Not only road safety programs to educate pedestrians, starting with children (Deluka-Tibljaš et al., 2021), but also programs to encourage the use of cycling and other sustainable modes of transport (Ordinez et al., 2021).

This training is truly important, since, despite being a consensus in the academic field (Alonso et al., 2023), the general population is still not aware that changing daily transport patterns is crucial for increasing environmental sustainability. Even in a developed European country, such as Poland, Zawieska and Archanowicz-Kudelska (2023) found that parents of schoolchildren in Warsaw do not fully understand the term "sustainable transport" and often associate it only with solutions that are economically inaccessible for most of the population. Therefore, when it comes to active transport by bicycle, Podgorniak-Krzykacz and Trippner-Hrabi (2021) emphasize that, beyond disseminating information about environmental benefits, health and economic issues should also be emphasized. In addition to active transport options, one can highlight, for example, that the success of Mobility as a Service (MaaS) requires more than just the deployment of technologies; it must also be supported, among other factors, by promoting environmental awareness and encouraging cultural transition (Lopez-Carreiro et al., 2023).

Agyeman and Cheng (2022) found that, in addition to educational training, family income, car ownership, and parents' driving licenses strongly influence the adoption of more sustainable transport habits by children. This is also proven by the finding that to abandon less sustainable modes of transport, it is necessary to focus on the daily mobility of children and adolescents, as well as on the norms, values, aspirations, and underlying socialization processes (including family dynamics), as unsustainable transport behaviors and mobility practices tend to be perpetuated across generations and can continue throughout life (Hopkins et al., 2021; Dütschke et al., 2022; Biondi et al., 2022). Even in developed countries, such as the United Kingdom and the United States, it is found that when it comes to behavior changes aimed at controlling global climate change, citizens are more likely to recycle household waste and improve domestic energy efficiency, rather than showing willingness to change their transport habits (Antronico et al., 2020). However, more sustainable transport habits (Chuvieco et al., 2021) and environmental awareness of travelers (Zhao et al., 2023) are among the main factors influencing citizens' lifestyles related to climate change.

On the other hand, European countries with more mature sustainable transport habits are more focused on training parents and children in schools for safer practices related to children's cycling (Wachnicka et al., 2023) and access to schools (Bina et al., 2021), rather than on building environmental awareness. Based on this, the first hypothesis to be tested in future studies, arising from this exploratory analysis, can be formulated: "The lack of studies specifically focusing on early childhood education and awareness of more sustainable transport habits may be related to the fact that, in developed countries with already established sustainable transport habits, the awareness of children and young people is not so much in need of attention, as they naturally grow up with these habits."

In countries that do not yet have the habit of using bicycles as a mode of transport, with the same argument that children shape the future and that their parents are role models for them (Bina et al., 2021; Wachnicka et al., 2023), it is believed that it is necessary to introduce content related to awareness of more sustainable transport habits in schools from an early age. In this regard, public interventions can change urban mobility in a city, among other factors, through educational programs (Mateu and Sanz, 2021; Cieśla and Macioszek, 2022), since occasional

educational campaigns, whether for road safety or awareness of more sustainable habits, are not sufficient, as they do not seem to have lasting results (Barić et al., 2020).

The education sector offers a still underexplored opportunity for successful climate change adaptation and mitigation through the construction of knowledge and skills and, consequently, positive behavioral changes (Apollo and Mbah, 2021). Current efforts often overlook the role of education in equipping people with the skills to cope with uncertain environmental futures (Apollo and Mbah, 2021). These authors also add that educating people about climate change is a vital measure to persuade populations, including school-age children, to play an active role in mitigation and adaptation actions. Active participation from the population is essential in the planning process to achieve greater sustainability in the transport sector, as it is through public opinion that the real needs of users are presented (Campisi et al., 2020). Proctor et al. (2020) further add that the school context can create more environmentally conscious young people.

In this direction, Alonso et al. (2023) emphasize that, especially in developing countries, measures to reduce air pollution often require profound behavioral changes among individuals who may (or may not) be willing to modify their habits. Moreover, the process of cultural change takes time (Frater and Kingham, 2020). Nevertheless, considering that Planet Earth is experiencing unprecedented levels of environmental degradation and destruction on a global scale, Ienna et al. (2022) emphasize that encouraging people to adopt behaviors aligned with a sustainable future will help address the current ecological crisis. Gunnarsdóttir et al. (2023) add that the biggest barrier to decarbonization is not just infrastructure, but people's mindset. In this regard, these authors stress the need for attitude change for school-age children through the promotion of climate education in general.

Thus, the second hypothesis to be tested in future studies suggests that "school-level education should have a strong environmental awareness foundation, focusing on the importance of more sustainable transport habits.". Education can make individuals feel more responsible for environmental protection (Barman, 2023; Lanzini et al., 2024), strengthening their personal principles as well as the general social norms for sustainable transport (Ienna et al., 2022). Therefore, updating the curriculum on natural disasters, enriching textbooks and training, as well as regularly updating teachers' knowledge, especially regarding sustainable development (Niens et al., 2021), can ensure the validity of the teaching (Palmos et al., 2021). Piscová et al. (2023) further add that environmental issues should be addressed in a separate school subject, as they do not receive sufficient attention in other subjects; they also note the lack of quality teaching materials on the subject.

Furthermore, the analyses conducted in Díaz-López et al. (2023) emphasize that, over the years, through school-level environmental education, it is possible to change consumption habits, promote the local economy, and reduce the environmental footprint. In the Brazilian context, the guidelines and legislation on traffic education (Brasil, 2009, 2024) do not focus on these issues of sustainable transport habits. The focus is much more on traffic education, aimed at road safety and accident reduction. To make matters worse, despite Brazil having comprehensive and incisive legislation on traffic education (Freire, 2020), traffic accidents are the leading cause of accidental death for children and adolescents aged five to 14 in Brazil (Criança Segura Brasil, 2020).

In addition, beyond the issue of children's awareness of more sustainable transport habits, despite the volume of legislation and guidelines regulating traffic education in Brazil, Freire (2020) emphasizes the scarcity of scientific production on the topic of traffic education, especially in the early years of basic education. Thus, supporting the view that there is a difficulty in the effectiveness of road safety activities in primary school education [Hong (2021), a case of Vietnamese schools,

a developing country], another hypothesis proposed by this exploratory review, which requires scientific analysis, is that the educational practices in Brazilian schools related to traffic education are not effective.

Although not focused on traffic education, Andreoni and Ruiz Vargas (2020) present a case study of sustainable development education projects implemented in primary schools in Bogotá (Colombia), which could serve as an example to reformulate traffic education practices in Brazilian schools, even incorporating issues related to more sustainable transport habits. Andreoni and Ruiz Vargas's (2020) research identifies examples of successful sustainability practices and contributes to the debate on bottom-up initiatives. These authors note that the multidimensional nature of sustainability education initiatives has been able to raise environmental awareness among students and communities and create a culture of sustainability that shapes the perceptions of younger generations.

In this sense, Silva et al. (2023) highlight the importance of implementing practical learning methods that can be adapted and adopted for different age groups, educational levels, and educational agents. For example, Turoń et al. (2021) highlight educational methods for primary education, such as storytelling, videos and cartoons, conversation cups, book work, questionnaires, educational games, among others. Among the only four articles that effectively address the role of basic education in building more sustainable transport habits, Rogelj et al. (2024) advocate for gamification strategies within schools to significantly change children's travel habits. The authors emphasize that, although the most significant change in travel habits occurred during the implementation of the practice, the results suggest that more lasting effects may also be achieved.

Similar to Rogelj et al. (2024), Silva et al. (2023) highlight the importance of incorporating play activities for children, noting that educational games can foster a deeper understanding and engagement with the topic. However, they emphasize that such activities must be carefully planned and contextualized, taking into account the dynamics of the target audience's daily life. Therefore, it is crucial to adapt the content to fit the school subjects and age groups through dynamic and innovative teaching tools, enabling children to relate to sustainable transport and feel motivated to adopt these habits.

This scenario, with the growing emphasis on incorporating more sustainable mobility practices into school curricula, presents a future challenge: ensuring that these initiatives are not limited to isolated projects but are fully integrated into the curriculum and everyday teaching practices, so that sustainable transport habits become ingrained in the culture of future generations.

4. FINAL CONSIDERATIONS

In addition to its socio-environmental contributions, this article stimulates, opens doors, and provides pathways for updating and enhancing educational practices aimed at fostering more sustainable transport habits in basic education, particularly in developing countries. It also offers valuable contributions to the academic field.

Initially, through the exploratory review, the incorporation of the concepts of "education on sustainable transport" (Rogelj et al., 2024) and "Education for Sustainable Development (ESD)" (Piscová et al., 2023) in the Brazilian context is highlighted. These concepts were identified during the review process as practices that have already been researched and implemented internationally.

Subsequently, through the bibliometric analysis, three key points emerge concerning the theme addressed in this article: i) journals where future studies could be published; ii) the multidisciplinary nature of the topic; and iii) the scarcity of specific studies. The analysis identifies 23 potential journals for publication, of which, based on the Qualis classification for the 2017-2020 period,

seven are A1 and nine are A2. Notably, Sustainability (with the highest number of publications) and Journal of Transport Geography (the only journal with a Brazilian-origin publication specifically addressing this theme) are emphasized. The selected articles stem from publications in eleven core CAPES areas: Engineering I, Engineering III, Engineering IV, Collective Health, Biodiversity, Environmental Sciences, Geography, Urban and Regional Planning/Demography, Education, and Teaching. Despite a total of 3,937 studies identified, only 42 were selected for review, and among them, only four focus on the specific theme of this research: basic education and the training of sustainable transport habits. The remaining articles concentrate on topics such as behavior and environmental awareness, public opinion, road safety, promotion of sustainable transport, and environmental education.

Finally, as the main finding from the narrative analysis conducted in this exploratory review, the article proposes three hypotheses to be tested and analyzed in future studies: i) the scarcity of studies focused on the relationship between basic education and the awareness of more sustainable transport habits may stem from the fact that, in developed countries with established sustainable transport habits, children's awareness of these practices is less emphasized. This is because children in such environments grow up surrounded by these habits as part of everyday life, reducing the need for specific educational interventions to promote them; ii) Including a stronger foundation of environmental awareness, with an emphasis on sustainable transport habits, in the school curriculum contributes to the development of more sustainable attitudes and behaviors regarding transport in students' adult lives; and iii) Educational practices related to traffic education in Brazilian schools are not sufficiently effective in promoting significant changes in students' behavior and awareness of traffic safety and sustainability.

It is important to note that these statements are not definitive conclusions but rather preliminary insights drawn from the narrative analysis of this exploratory review. Future studies are encouraged to test the validity of these hypotheses. Additionally, it is essential to highlight that the results presented in this article are based on the information gathered through the searches conducted in this study.

AUTHORS' CONTRIBUTIONS

All roles were performed by the main author.

CONFLICTS OF INTEREST STATEMENT

Nothing to declare.

USE OF ARTIFICIAL INTELLIGENCE-ASSISTED TECHNOLOGY

ChatGPT was used to assist with translation.

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