International Journal of Engineering and Science Invention (IJESI)
ISSN (Online): 2319-6734, ISSN (Print): 2319-6726
www.ijesi.org ||Volume 15 Issue 6 June 2026 || PP 32-43

Development of Educational and Technological Strategies To Reduce Pedestrian Traffic Accidents in The Timiza Neighborhood of The Kennedy District, Bogotá D.C.

Ingrid Vanessa Alarcón Muete[1], Ever Fuentes Rojas[2]
[1](Bogotá, D.C., School of Engineering / Universidad Libre, Colombia)
[2] (Bogotá D.C, School of Engineering/ Universidad Libre, Colombia)

ABSTRACT: *This article presents the proposal of an industrial 4.0 tool aimed at generating pedagogical and technological strategies for reducing road accidents in the Timiza neighborhood of the town of Kennedy, Bogotá, D.C. where it is identified that road accident is a global issue that poses a challenge in terms of road safety and public health. Bogotá, is one of the cities in Latin America that has bet most on the continuous improvement of mobility in all road actors, having two important pillars, the reduction of road accidents through the public policy "zero vision" and sustainability through the public policy "Bogotá Reverdece". It is for this reason that what the project integrates participatory education activities through citizen culture campaigns along with technological tools focused on industry 4.0, which will promote behavioral changes of citizenship in the study area and will allow the monitoring of road accidents in the sector to support decision-making, and promoting pedestrian self-care alerts. This strategy is proposed as an adaptable and evaluable pilot plan, with the possibility of replicability in other urban sectors.*

KEYWORDS-*Pedagogy, technology, industry 4.0, mobility, accidents.*

Date of Submission: 06-06-2026 Date of acceptance: 16-06-2026

I.INTRODUCTION

When discussing traffic accidents, the term carries connotations of disaster and is generally associated with painful situations, such as serious injuries or loss of life, which could have been prevented through individual responsibility and self-regulation. In this context, it differs from a traffic accident, which is an unpredictable event associated with chance and beyond one's control [1], for this reason, this article addresses accident rates as the subject of study, since, given their connotations, they can be reduced through increased awareness among road users; nevertheless, this is a never-ending issue, as it is the leading cause of death among young people worldwide, with a greater impact in less developed countries, making it a public health problem.

It is essential to address the consequences of a traffic accident, such as the loss of a life, disability, and recovery from injury, as well as the psychological, financial, and social impacts on the victim and their family. Turning to the issue at the national level, there have been a large number of injuries and fatalities; for this reason, traffic accidents are a major concern in most countries, as they are considered a public health problem and have placed an overwhelming economic, health, and social burden on nations worldwide [2].

Given the global nature of this issue, when focusing on Bogotá, D.C., several public agencies have issued annual reports on this factor, which accounts for a high number of fatalities. In 2024, according to the Traffic Management Center and the District Secretariat of Mobility, it was found that motorcyclists were the road users with the highest accident rate in the city and also the primary cause of traffic accidents involving pedestrians. This demonstrates that, although the study focused on pedestrians, corresponding research was also conducted on regulations governing other road users.

Pedestrian mobility in Bogotá is a matter of great importance when considering sustainable transportation—an issue currently under review—especially given that pedestrians are considered the most vulnerable of all road users, with a total of 207 fatalities recorded regionally by 2024. This study focused on the Timiza neighborhood in the Kennedy district, the area with the highest pedestrian accident rate in the city. It is also a busy area for all road users, as it features a major thoroughfare (Avenida Primera de Mayo) and is home to the Kennedy Hospital, making it an ideal location for this research.

The Kennedy district is the second most populous district in the city; it covers an area of 3,859 hectares and has a total population of 1,037,929 [3]. It is an area with several major access routes and connections to other neighborhoods, including Boyacá Avenue, Primera de Mayo Avenue, Ciudad de Cali Avenue, Avenida de las Américas, Calle 13, and Villavicencio Avenue. A look at the streets listed above reveals that this is an area with heavy traffic and a correspondingly high number of accidents.

According to studies conducted by the District Secretariat of Mobility and the Mayor's Office of Bogotá, the traffic accident rate in the Kennedy district in 2022 indicates that there were more than 3,000 accidents, with one serious accident occurring every 5 hours and one fatal accident every 6 days and 13 hours, which is a significant figure when considering pedestrians as road users, with a total of 197 fatalities, 21% of which were caused by being struck by a vehicle [4].

II.MATERIALS AND METHODS

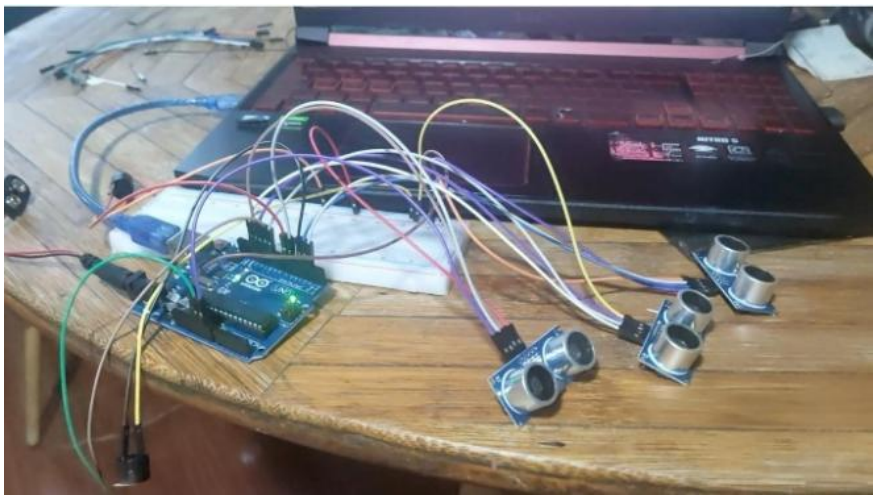
In order to gain a better understanding of the qualitative and quantitative research for this project, fieldwork was conducted in the target population located at the intersection of Avenida Primera de Mayo and Calle 40 Sur in the Kennedy neighborhood of Timiza. The survey of the area identified various issues in the sector, including infrastructure and citizen behavior.

Following that, a survey was conducted to gauge the perceptions of 308 people regarding mobility and accident rates in the area. The survey gathered information ranging from general data—such as age, place of residence, and place of work—to more specific details that help identify biases, thereby revealing people's perspectives based on generational and socioeconomic factors. The sample included individuals aged 18 to 78 who regularly crossed the intersection in question.

A literature review was conducted on topics such as civic awareness campaigns at the regional, national, and international levels; the identification of their impact on society; the development of new educational initiatives aimed at reducing traffic accidents; and Industry 4.0 tools that have been implemented in various neighborhoods across Bogotá, with a focus on determining whether they have had a positive effect on traffic accident rates.

- Finally, a physical simulation of the project was carried out using a model equipped with an Arduino, which performed the sound simulation process, as shown in Figure 1.

Figure 1. Electrical tools



Sources: authors, 2025.

The purpose of the model is to represent the target area on a 1:60 scale. Using an Arduino UNO, it simulates how the Industry 4.0 tool would function in the area, with the goal of alerting pedestrians to a potential traffic accident via an audio signal. This signal detects the speed of the vehicle and, in the event of a potential risk, triggers an alarm. In the model, this is shown in a single area of the site, but the pilot program would be implemented at all four traffic lights in the project area.

III. RESULTS

Civic culture refers to the set of attitudes, beliefs, and behaviors that enable the community to participate responsibly and actively, both as individuals and as members of a community. Over the years, in the city of Bogotá, it has not only become a cultural approach but has also evolved into a public policy that promotes social transformation through self-regulation and mutual regulation in different areas of the city [8].

One of the current approaches being considered when examining civic culture is to focus not only on vehicles but also on people, by transforming attitudes and beliefs regarding other road users, with the aim of improving coexistence on the road [9], which is why government agencies in various municipalities, as the country grows and amid the technological boom, have taken measures to support these initiatives—not only cultural ones, but also those aimed at transforming mobility in general.

The focus on civic culture campaigns began during Antanas Mockus mayoral terms (1995–1997 and 2001–2004), when he sought to promote compliance with civic norms and harmonious coexistence among citizens, basing these efforts on communication strategies [10], but over time it became clear that these efforts alone would not be sufficient to ensure safe traffic conditions. Consequently, alongside the digital transformation, the city turned to Industry 4.0 tools and regulatory agencies to further improve these initiatives in Bogotá.

In 2017, the city launched the Traffic Management Center, an entity that enables Bogotá to track statistics on factors such as speed, the flow of traffic, and accident rates. This information allows for the development of decisions and strategies that promote competitiveness, sustainability, and the quality of life for citizens. This entity enables not only the District Secretariat of Mobility to collect statistics, but also all citizens.

These two processes have enabled Bogotá to achieve growth in terms of mobility, as the city has received various awards for initiatives such as sustainability [11], excellence in road safety, and efforts to reduce the gender gap in transportation [12], and, finally, for pursuing strategies that reduce traffic accidents and enable fast and safe traffic flow in the capital, ranking among the top 60 cities striving for sustainable mobility [13].

3.1. CITIZENSHIP AWARENESS CAMPAIGNS

In Bogotá, various types of civic awareness campaigns have been implemented, focusing on the protection of and respect for all road users, with pedestrians identified as the target audience. To review these campaigns, a table was created that highlighted aspects such as the project duration, the target population, the areas or locations covered, the issues addressed, statistics, and an analysis of each campaign.

- Think about it: we're all pedestrians. This public policy campaign, launched in October 2018, aimed to raise awareness of pedestrians as the most vulnerable road users in the city. This educational strategy was accompanied by enforcement measures and infrastructure improvements, with the goal of reducing accident and fatality rates for that year [14].

Table 1. Fact Sheet: Look Out, We're All Pedestrians

	LOOK OUT—WE'RE ALL PEDESTRIANS
VALIDITY PERIOD	2018-2019
START AND END OF THE PROCEDURE	October 17, 2018, to December 29, 2019
TARGET POPULATION	Motor vehicle drivers, motorcyclists, cyclists, pedestrians, and passengers
AGE OF THE POPULATION	From age 10 to age 70
INTERVENTION AREA	Seventh race with 72
	13th Street and 65th Street (intersection)
	1 de Mayo Ave. - 40 B South
	Cl 100 - KR 15
	Cl 100 - kr 19
ISSUES ADDRESSED IN 2017	Fatalities: 272 pedestrians in 2017
2018 STATISTICS	Fatalities: 245 pedestrians in 2018
2019 STATISTICS	Fatalities: 236 pedestrians in 2019
ANALYSIS	The statistical analysis shows that fatal pedestrian accidents in the 2018–2019 period decreased, with a total of 36 fatalities—a 13% decrease compared to the year the study began

Sources: authors, 2025.

As shown in Table 1, during the period in which the intervention was carried out, pedestrian traffic accidents were reduced by 13%. It was observed that, although this approach cannot, on its own, bring about improvement, raising awareness among all road users led to positive progress in line with the guidelines of the "Vision Zero" public policy [15].

Table 2 shows the decline in traffic accidents during October, November, and December between 2017 and 2019, with the aim of identifying the reduction in traffic accidents closer to the start of the campaign.

Table 2. Fatal pedestrian accidents, 2017–2019

	2017	2018	2019
OCTOBER	44	39	61
NOVEMBER	41	41	33
DECEMBER	55	38	41
TOTAL	140	118	135

Sources: authors, 2025.

Table 2 shows that, while there was a decrease in traffic accidents in October, November, and December, in the 2017–2018 period, with a total of 22 people, corresponding to 16%, on the other hand, Table 3 shows how the type of vehicle—such as cars, taxis, and freight transport—affects road accident rates during this period, indicating whether there was a reduction in accidents on public roads.

Table 3. Fatalities by vehicle type before and during the campaign

	PRE-CAMPAIGN	DURING THE CAMPAIGN	
	2017	2018	2019
BICYCLE	3	1	4
MOTORCYCLE	74	80	85
LIGHT VEHICLE	86	66	50
PUBLIC TRANSPORTATION BUSES	49	50	52
TAXIS	21	10	13
FREIGHT TRANSPORTATION	23	15	18
MORE THAN TWO ROAD USERS	16	23	14
TOTAL	272	245	236

Sources: authors, 2025.

- You are at the heart of the new mobility. This public policy campaign aims to establish Bogotá as a city with viable accessibility, infrastructure, and safety conditions to improve the quality of mobility for pedestrians, allowing them to enjoy the public spaces designated for them. This is achieved through factors such as culture, safety, infrastructure, and governance, addressing issues related to the population, gender equality, and territorial considerations.

In the year this campaign was launched, 3,200,000 pedestrians were identified who walk for approximately 15 minutes daily, accounting for 23.9% of the city's total daily trips. Nearly 2,000,000 of these pedestrians are women, representing 61.5% of the total, the main demographic using this mode of transportation consists of children and adolescents, accounting for 43.15%, followed by older adults, who account for 30.61%.

This public policy is being presented for public consultation for the period 2023–2035, with the aim of reducing traffic accidents and thefts in Bogotá—daily problems that have led to a decline in pedestrian mobility in the city. For this reason, the following statistics are provided: Between 2018 and 2022, 1,211 pedestrians died; 197 of them died in traffic accidents in 2022. Of these, 67% were men, 24% were women, and 9% had no gender information available; 38.3% were people over 65 years of age.

This is considered a very comprehensive public policy because it addresses not only raising awareness but also identifies other areas in need of improvement, such as infrastructure (sidewalks in poor condition, unsafe crosswalks, and pedestrian bridges that are dilapidated or plagued by theft). It is the combination of these two factors that enables safe mobility for pedestrians. The goal is to improve travel by this mode of transportation by making it safer and more accessible, to promote safe spaces—such as parks or the sidewalks themselves—so that pedestrians feel safer when they go out, and to reclaim spaces that have already been built [16].

- Vital Neighborhoods. A project of the District Mobility Secretariat that aims to benefit pedestrians by reallocating public spaces currently designated for vehicles, but through infrastructure interventions, new areas are created for pedestrian flow, facilitating aspects such as the interaction between residents and visitors to the area, improvements in environmental conditions, and ultimately, road safety, by designating zones for pedestrians, areas for freight vehicles, and parking spaces [17].

An analysis was conducted which found that, although it is an option for safe mobility on Bogotá's roads and promotes pedestrian traffic at various times of the day, it did not result in a significant improvement in the city's traffic accident rates; rather than decreasing, the numbers increased, with one fatality and fifteen injuries reported in 2022, and by 2023, the number of fatal accidents had risen to four and the number of injuries to fifteen compared to 2022. This indicates that, according to the concept under study, the project was not viable, as traffic accidents increased rather than decreased.

- Good things are happening at TransMi. This campaign is organized by the Secretariat of Culture, Recreation, and Sports (SCRD) and the District Institute for the Protection of Children and Youth (IDIPRON). The goal of this initiative is to promote respect, solidarity, and harmony among pedestrians who use Transmilenio's trunk and local buses. This project is carried out through educational and artistic initiatives within the system; in addition, monitoring and research strategies are implemented to foster a sense of belonging and ownership among people regarding the public transportation they use [18].

As noted in the fact sheet, the public awareness campaign "Good Things Happen When You Cut In" takes a different approach from the one being explored in this study; although cutting in is a high-risk factor for traffic accidents, there are no figures on fatalities from this cause during the period when the campaign was carried out; the data available is very general until the 2024 traffic accident yearbook is published, which provides greater visibility into road accidents by road user [19].

- World Pedestrian Day. A civic awareness campaign that commemorates World Pedestrian Day every August 17 in cities such as Bogotá, Cali, and Medellín. Through educational initiatives, these cities carry out awareness programs highlighting that pedestrians are the most vulnerable road users, targeting specific areas to engage citizens in their role as road users.

In the city of Medellín, the civic awareness campaign "When a pedestrian cross, it's life itself that's passing by" was launched, promoting a culture of respect and tolerance among all road users in the city. This initiative took place starting at 7:00 a.m. at Avenida Oriental and La Playa. The project reached 50,000 people. It is a very interesting civic awareness campaign, but since it lasted only one day, people may easily forget what they learned over the course of the year [20].

Table 4. Traffic Accident Indicators for Pedestrians in Antioquia

	INDEX OF TRAFFIC ACCIDENTS INVOLVING PEDESTRIANS IN ANTIOQUIA		
	2022	2023	2024
DEATHS	242	255	257
INJURED	574	565	498

Sources: authors, 2025.

In the city of Cali, an awareness campaign was held on Pedestrian Day. The District Secretariat of Mobility, together with the National Road Safety Agency (ANSV), carried out the activity at the intersection of Calle Quinta and Carrera 36, in southern Cali, where they educated more than 100 people and discussed respect for traffic signals. The campaign targeted all road users, promoting accident prevention [21].

Table 5. Traffic Accident Indicators for Pedestrians in Valle del Cauca

	INDEX OF TRAFFIC ACCIDENTS INVOLVING PEDESTRIANS IN THE CAUCA VALLEY		
	2022	2023	2024
DEATHS	208	203	246
INJURED	385	372	406 [22]

Sources: authors, 2025.

Finally, in Bogotá, the Secretariat of Mobility, the Road Maintenance Unit, the Undersecretariat of Civic Culture and Knowledge Management, and the Secretariat of Culture, Recreation, and Sports joined forces in the creative district of San Felipe. In this city, a performance art event was held in which pedestrians walked across a red carpet and named "the most important actor." According to statistics from this same event for the year 2022, 28,000 people were engaged in 17 locations, with a total of approximately 460 interactions [23].

Table 6. Traffic Accident Indicators for Pedestrians in Bogotá

	INDEX OF TRAFFIC ACCIDENTS INVOLVING PEDESTRIANS IN BOGOTÁ		
	2022	2023	2024
DEATHS	230	245	244
INJURED	1180	1097	1020

Sources: authors, 2025.

As can be seen in Tables 6, 7, and 8, it is evident that, unfortunately, traffic accidents involving pedestrians have been increasing over the years, due to the fact that the number of vehicles in different cities is increasing every day, along with factors such as speeding, drivers running red lights, and pedestrians jaywalking—a problem primarily of public awareness rather than the need to improve the road network.

In addition to reviewing data from public awareness campaigns, the study also analyzed Industry 4.0 technologies that have been implemented in various areas of Bogotá, where positive changes have been observed in driving behavior and the actions of different road users as they move around the city, including features such as smart traffic lights and safety cameras, among other elements, which have transformed mobility over the years.

Over the years, Industry 4.0 has integrated advanced technologies such as the Internet of Things, artificial intelligence, smart automation, and big data, and mobility in Bogotá has been growing and improving with elements such as sensors installed at strategic points throughout the city to monitor traffic flow and perform advanced analysis, thereby facilitating decision-making and optimizing traffic in the city. In addition, artificial intelligence currently plays a key role in automation; for example, dynamic adjustments to traffic lights based on real-time vehicle and pedestrian traffic patterns [24].

For this reason, a table was created to illustrate how Industry 4.0 has improved mobility in different areas of Bogotá, examining aspects such as the date of implementation, strategy, target audience, locations where the projects were implemented, project objectives, and, finally, an analysis of each project. Following this, tools that have been implemented in other areas of the country or Bogotá were reviewed, which could be implemented in the study area.

A review was conducted of existing public policy initiatives, such as the "Bogotá Reverdece 2022–2035" Land Use Plan—a project that, through initiatives like "Barrios Vitales," "Bogotá a Cielo Abierto," the construction of the five metro lines, and the 7th Avenue green corridor, seeks to reclaim public space for pedestrians and present the city as a destination that is attractive to tourists, commercially viable, and safe for all road users [25].

The entities to which the project proposal in question can be submitted were identified as the District Secretariat of Mobility, the Kennedy Local Mayor's Office, the Institute of Urban Development, the District Secretariat of Planning, and the Ministry of Transportation—all of which are interested in improving mobility in the Timiza neighborhood of the Kennedy district—but which, depending on their specific focus, may or may not be taken into account, in addition to issues such as the budget and interest in the project focused on pedestrian space.

Finally, a review of socio-educational aspects and descriptive and projection studies was conducted, resulting in a public policy proposal focused on Industry 4.0 that enables a dynamic analysis of pedestrian mobility at the intersection of Calle 40 Sur and Avenida Primera de Mayo in the Kennedy neighborhood. This process was carried out using a physical simulation (scale model), which demonstrates the interaction between infrastructure, civic culture, and, finally, the measures intended to reduce pedestrian accidents.

The methodological approach for this simulation is quantitative, as it will examine the widths of sidewalks and roadways, distances between intersections, the number of traffic signals along the route, and the

volume of pedestrian, bicycle, motorcycle, and vehicle traffic in the area. This information will be scaled down and incorporated into the model. The following steps were taken to carry out the simulation:

Scale design: Using the relevant dimensional data, along with architectural elements sourced from public records, we have established the basic framework of the intersection, which will serve as the foundation for building the model. Figure 2 shows the street that was the subject of the study and on which the physical simulation will be designed.

Figure 2. Satellite urban map of 40th Street South and First of May Avenue

Sources: authors, 2025.

Design and construction: The architectural plan for the study area—"Avenida Primera de Mayo at Calle 40 Sur"—was printed on adhesive paper.

After that, it was cut to fit the industrial cardboard, aiming to capture the key points of the area in the model to be created, so that it could be glued to the cardboard and serve as a base for beginning the 3D modeling process.

Figure 3. Pedestrian areas (green spaces and subway area) in the model

Sources: authors, 2025.

While the model was being assembled, the Arduino was programmed to control the buzzer, in order to simulate the sound of a vehicle passing by at high speed.

Figure 4. Arduino Programming

Sources: authors, 2025.

Physical tests are conducted on the Arduino to determine the sounds emitted when a moving object is nearby, with a focus on time and distance.

The Arduino was installed on the model to conduct the tests required for the project, during which the speed of each component was determined.

Figure 5. Arduino prototype

Sources: authors, 2025.

The necessary tests were conducted on the simulation to demonstrate how it works. As a car passes by, an alarm sounds. It is important to note that, due to the size of the model, only one buzzer could be installed; however, in accordance with the pilot plan, a buzzer must be added to each traffic light in the project to ensure full coverage. This process would be carried out in conjunction with the marking of crosswalks and stop lines to ensure greater visibility for pedestrians.

IV. ANALYSIS OF RESULTS

A sample was selected with a 95% confidence level, which was significantly biased toward the target population; nevertheless, the data collected was essential for identifying citizens' perceptions and determining the focus of the study in question.

By examining the open-ended question included in the survey, it is possible to identify which tools people believe would reduce traffic accidents; factors such as education, civic culture, and infrastructure elements like traffic lights and speed bumps, among others, were key considerations in selecting the tools to be developed in the public policy proposal.

The review of the study topic, "Pedestrian Traffic Accidents in the Timiza Neighborhood of Kennedy," provided an initial overview of how the statistics have trended over the years and which factors are expected to be reduced upon implementation of the pilot program.

The review of civic awareness campaigns was a key factor, as it made it possible to identify the statistics for each initiative and, in this way, determine which one would be most appropriate for public policy planning, based on the reduction in accident rates over the duration of each campaign.

Studying projects by private entities such as Transmilenio provided a broader perspective on mobility in general, revealing that pedestrians do not only get around on foot but also use other modes of transportation—primarily public transit. Observing the awareness campaigns carried out by these entities makes it possible to engage private organizations that can help reduce traffic accidents.

An overview of Industry 4.0 and the tools that have been implemented on a daily basis to improve mobility in the Timiza neighborhood of the Kennedy district has provided accurate data on accident rates in the area, smart traffic lights, and pedestrian-focused initiatives designed to raise awareness when addressing issues related to walking and its associated risks.

Identifying other aspects of Industry 4.0, such as the mobile apps being used by government agencies—like Gaze with the District Secretariat of Mobility and the TransMi app—are also tools that people use all the time for safe and fast transportation around the city, serving as easily accessible resources that improve the lives of citizens.

Identifying measures from other parts of the country or from Bogotá that could be implemented in the study area made it possible to determine which measure would be most effective in reducing the number of traffic accidents at the intersection of Primera de Mayo and Calle 40 Sur.

Proposing a public policy campaign is a complex undertaking when it comes to reviewing the factors that must be met for its implementation; for this reason, it became clear that viewing this project as a technological strategy for an existing initiative is more conducive to the proposal's successful implementation.

It became clear that several public entities support these types of strategies, ranging from government agencies—such as the Ministry of Transportation, whose primary focus is reducing traffic accidents—to the local Kennedy mayor's office, which focuses on the continuous improvement of the community, in this case in terms of mobility.

A review of government agencies revealed the opportunities available for carrying out the project; for example, the District Secretariat of Mobility and the Kennedy Local Mayor's Office are the most suitable for implementing the project.

Physical simulation is a tool that allows you to see at a glance how the project works; a 1:60 scale model can demonstrate its functionality. However, when conducting the necessary tests, only a buzzer could be installed, limiting the ability to verify the proposed design for the pilot program.

In conclusion, conducting research using bibliographic data for the preparation of this proposal was a wise decision, as government agencies and publications from other projects serve as benchmarks for developing a proposal that meets Bogotá's mobility requirements, taking into account the city's constant growth and the need to explore new technological strategies.

V.DISCUSSION

The pedestrian mobility of older adults in Bogotá, D.C., as analyzed by Ángel Chaparro (2023), demonstrates that walkability is not solely a structural issue; rather, factors such as socioeconomic conditions, characteristics of the urban environment, and the varying capabilities of the population also affect the effective functioning of crosswalks. This approach is of great importance for this article, as it broadens the perspective on understanding traffic accidents beyond the individual behavior of road users, incorporating environmental factors that also pose risks.

In this regard, the author identifies that older adults face multiple factors that hinder their ability to walk, including deteriorated sidewalks, poor visibility of safe crosswalks (zebra crossings) due to faded markings, insufficient pedestrian signal times—which highlight the priority given to other road users—and, finally, constant exposure to high-speed traffic. These risk factors not only hinder independent mobility but also increase the likelihood of a traffic accident. This situation is particularly prevalent in urban contexts such as the Kennedy district, where neighborhoods like Timiza feature high-traffic areas, informal commerce on sidewalks, and limited dedicated infrastructure, creating hazardous conditions.

In addition, Ángel Chaparro (2023) notes that socioeconomic conditions do have a direct impact on the quality of pedestrian mobility. Populations with lower incomes tend to live in areas with less investment in urban infrastructure, which creates inequality in the walking experience. This relationship is important for the article because it allows us to identify that traffic accidents are not distributed randomly, but rather follow territorial and social patterns that must be addressed through targeted interventions.

Based on the foregoing, it is clear that the problem of pedestrian traffic accidents—the main focus of this article—cannot be resolved solely through physical interventions, but rather requires a comprehensive approach. In this regard, the findings highlighted by Ángel Chaparro (2023) are directly relevant to the proposal, as they justify the need to implement educational and technological strategies from Industry 4.0 that influence civic culture, risk perception, and decision-making among road users.

In particular, the educational strategy addresses unsafe behaviors stemming from a lack of traffic safety education and the normalization of risk in complex urban settings. At the same time, the incorporation of technologies such as sensors, real-time data analytics, and digital awareness-raising tools can help identify accident hotspots, monitor behaviors, and develop more efficient and context-specific interventions.

In conclusion, the analysis of pedestrian mobility among older adults in Bogotá provides a fundamental interpretive framework for understanding pedestrian traffic accidents from a systemic perspective. This approach supports the argument that reducing accidents in contexts such as the Timiza neighborhood requires not only infrastructure improvements but also a transformation of the social and cultural dynamics associated with the use of public space—an objective that aligns with the article's proposal.

VI. CONCLUSION

The proposal aims to develop educational and technological strategies to reduce traffic accidents in the Timiza neighborhood of the Kennedy district in Bogotá, D.C. However, an analysis of the traffic accident landscape reveals that this issue extends beyond the local level, emerging as a global challenge in the areas of public health and sustainable urban development. Accordingly, the World Health Organization warns that traffic accidents remain one of the leading causes of death, primarily affecting pedestrians, motorcyclists, and cyclists [26], which reinforces the relevance of this study.

In the context of Bogotá, the figures paint a critical picture. According to the 2024 Road Accident Yearbook, there were 565 fatalities, equivalent to 7 deaths per 100,000 inhabitants. While motorcyclists represent the most affected group (47.3%), pedestrians—especially older adults—have a high mortality rate, with many cases associated with being struck by motorcyclists [27].

For its part, the 2023 Bogotá-Region Mobility Survey provides further insight into this situation by showing that people over the age of 65 account for 10.25% of all trips in the city, with approximately 1,714,421 daily trips. Of these, 47.14% are made on foot and 24.47% by public transportation. However, although this demographic group constitutes about 15% of the population, it accounts for 74% of pedestrian deaths, highlighting a critical issue that requires priority attention [29]. This disparity highlights a failure on the part of government agencies regarding the most vulnerable groups.

In this context, the effectiveness of traditional road safety education strategies is being called into question. Although these strategies have sought to change risky behaviors, the high number of traffic accidents suggests that their impact has been limited when civic culture and Industry 4.0 are considered in isolation. for this reason, the integration of technological and pedagogical tools is proposed, allowing not only for intervention but also for measuring and evaluating the impact in the area, noting that the principle "what is not measured cannot be controlled" underscores this need.

One of the proposal's main contributions lies in the integration of educational and technological strategies, which represents a step forward compared to traditional intervention models. This integration not only fosters public awareness but also generates accurate data that facilitates the ongoing evaluation of implemented actions. In this way, the use of technological tools contributes to more informed decision-making, increasing the effectiveness of interventions. Furthermore, the territorial context of the study area offers favorable conditions for implementing a pilot plan, due to its high volume of road users and its significance within an urban dynamic. This provides an appropriate setting for analyzing behaviors and measuring real-world impacts. In this regard, the proposal holds significant practical value in the field of urban mobility.

However, significant limitations have been identified, such as the lack of empirical validation, uncertainty regarding resource allocation, and a lack of information on public acceptance. These conditions highlight the need to implement the proposed real-world environment, which would allow for the assessment of its impact using specific indicators. Consequently, it is argued that the development of a pilot program with ongoing monitoring and evaluation is essential to determine its effectiveness and feasibility.

Based on these results, it is determined that the proposal can be developed as a pilot program with periodic updates, with the aim of gathering real-world data regarding its implementation, including indicators such as public perception, compliance with the regulations, and whether it contributes to reducing pedestrian accidents. Following this, it will be possible to determine whether its functionality meets the needs of the area; if so, it can be implemented in other parts of the town, or conversely, if it is not well received, it can be discontinued.

REFERENCIAS

[1] Bogotá Department of Education, *Protocol for Handling Traffic Accidents at Educational Institutions in the Capital District*, n.d. [Online]. Available at: Anexo 11 protocolo_atencion_siniestros_viales_Establecimientos_edu.pdf.

[2] Secretariat of Mobility, *Bogotá Traffic Accident Yearbook 2024*, 2024. [Online]. Available at: anuario-siniestralidad-vial-2024-digital.pdf.

[3] Secretariat of Social Integration, *Kennedy 2025 Local Assessment, 2025*. [Online]. Available at: https://www.integracionsocial.gov.co/images/_docs/2025/Entidad/localidades/12052025-8-Kennedy-Diagnostico-2024.pdf.

[4] District Mobility Secretariat*, Preliminary Report on the Kennedy District: Accountability Report of the District Mobility Sector for 2023*, 2023. [Online]. Available at: informe_preliminar_i_semestre_2023_localidad_kennedy.pdf.

[5] The Bogotá District Education Secretariat, *inaugurated Kennedy Public University in southwest Bogotá*, 2022. [Online]. Available at: https://educacionbogota.edu.co.4

[6] Julio Garavito Colombian School of Engineering, *A Forensic Analysis of Motorcycle Accidents in Colombia*, 2023. [Online]. Available at: https://www.escuelaing.edu.co.

[7] Bogotá Mayor's Office, *"What Is Civic Culture in Bogotá?"*, 2020. [Online]. Available at: https://bogota.gov.co.

[8] Civic Culture, *Mobility*, 2020. [Online]. Available at: https://culturaciudadana.gov.co.

[9] M.I. Serrano Ariza, *Civic Culture Through Media Coverage: An Analysis of the Antanas Mockus Case in Bogotá*, undergraduate thesis, Pontificia Universidad Javeriana, Bogotá, 2017.

[10] Bogotá Mayor's Office, "*Bogotá Receives International Recognition for Leading the Way in Sustainable Mobility*," 2022. [Online]. Available at: https://bogota.gov.co

[11] District Mobility Secretariat, "*Mobility Recognized for Reducing the Gender Gap in Transportation*," 2023. [Online]. Available at: https://movilidadbogota.gov.co.

[12] Sustainable Economy, Sustainable Mobility: *Ranking of Cities with the Most Sustainable Transportation—Is Buenos Aires on the List?* 2023. [Online]. Available at: https://economiasustentable.com.

[13] District Mobility Secretariat, "*The Pedestrian Squad Arrives in Bogotá: 'Look Out—We're All Pedestrians*," 2018. [Online]. Available at: https://movilidadbogota.gov.co.

[14] National Road Safety Agency, *Historical Data on Victims*, 2024. [Online]. Available at: https://ansv.gov.co.

[15] District Mobility Secretariat, *Appendix 3: Public Policy on Pedestrians*, 2023. [Online]. Available at: 25052023 CORTA-PPT.

[16] District Mobility Secretariat, *Barrios Vitales, 2024*. [Online]. Available at: https://movilidadbogota.gov.co.

[17] Datos Abiertos Bogotá*, Bogotá Traffic Accident Yearbook 2021*, 2021. [Online]. Available at: anuario-de-siniestralidad-vial-de-bogota-2021.pdf.

[18] Medellín City Hall, *With the campaign "When a pedestrian crosses, it's life that's crossing," Medellín City Hall raises awareness among road users*, 2023. [Online]. Available at: https://medellin.gov.co

[19] City of Cali, *Cali Celebrates World Pedestrian Day with a Road Safety and Public Education Campaign*, 2024. [Online]. Available at: https://cali.gov.co
[20] National Road Safety Agency, *Victim Statistics*, 2024. [Online]. Available at: https://ansv.gov.co
[21] Cultura Ciudadana, *World Pedestrian Day with Cultura Ciudadana, 2023*. [Online]. Available at: https://culturaciudadana.gov.co
[22] I. García-de-la-Cruz and L. Chancay-García, "Smart Traffic Signals: An Analysis of the Challenges in Implementing IoT Technologies and Algorithms," Revista Tecnológica ESPOL, vol. 36, no. 1, 2024. [Online]. https://doi.org/10.37815/rte.v36ne1.1189.
[23] Bogotá Mayor's Office, *POT – Bogotá Reverdece 2022–2035*, 2022. [Online]. Available at: https://bogota.gov.co.
[24] World Health Organization, *Global Road Safety Report 2023*, 2023. [Online]. Available at: https://www.who.int.
[25] Bogotá Mayor's Office, *47.3% of traffic accident fatalities were motorcyclists*, 2025. [Online]. Available at: https://bogota.gov.co.
[26] District Mobility Secretariat, *2023 Mobility Survey Report*, 2023. [Online]. Available at: https://movilidadbogota.gov.co.
[27] A. Ángel, *"The Quality of Pedestrian Mobility Among Older Adults in Bogotá: A Review of Socioeconomic Conditions and Factors That Inhibit and Promote Walkability for This Population,"* master's thesis, National University of Colombia, Bogotá, 2025. [Online]. Available at: https://repositorio.unal.edu.co/items/9c820f1e-fe33-4d7a-89e5-da626804d16c.
[28] F. Walugembe, C. N. Le, and S. Chaiwong, "Effectiveness of road safety education in reducing teenage traffic accidents: A systematic review," *WE Journal of Posthumanism*, 2024.
[29] District Mobility Secretariat*. 2023 Bogotá–Region Mobility Survey Report. Bogotá: Bogotá Mobility Observatory*, 2025. Available at: Cartilla Encuesta de Movilidad 2023