

Assessment of children's mobility by means of urban school furniture in the surroundings of a primary school.

The case of tarek ibn ziad school - guelma city (algeria)

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Abstract

The area around schools, as a sensitive public space, needs to be treated in a way that enhances the comfort of schoolchildren in a welcoming space by improving their intensive daily interaction. The mobility needs of children around schools can be met by street furniture if it is designed to be safe, distinctive, accessible, functional and sustainable as well as promoting the health and well-being of pupils. The aims of this research are: to analyse the relationship between children's mobility and urban furniture surrounding schools using multi-attribute analysis; to raise children's awareness of their urban citizenship rights as key users; and to help local elected representatives make decisions through a flexible, participatory process. In order to collect quantitative and qualitative data for each type of urban furniture, two steps were taken: on-site observation and a school survey by questionnaire involving 137 pupils aged between 06 and 12, with the help of their parents, based on children's norms in school zones. As a case study, the primary school of Tarek Ibn Ziad and its surroundings were selected. The data collected will be used to analyze the suitability of this micro-element and its impact on children's mobility. The results show the marginalized situation of urban furniture around schools, which is considered unsuitable for children and has a negative impact on their mobility behaviors. This requires for a second level of negotiation with local authorities and stakeholders in order to co-resolve the problems through sustainable and participatory actions aimed at guaranteeing a welcoming school environment.

Key words: urban furniture, surroundings of primary school, children's mobility, multi-attribute analysis, suitability, Tarek Ibn Ziad Primary School, Guelma.

List of abbreviations

AHP	Analytic Hierarchy Process
CFS	Child Friendly space
CFD	Child Friendly Design
SDG	Sustainable Development Goals
UN	United Nations
UNICEF	United Nations of International Children's Emergency Fund
WHO	World Health Organization

1-Introduction

Reconciling children with the urban world is a major challenge that requires an intense effort on the part of scientific researchers. The issue first came to the fore with the promulgation of the Children's Rights in 1989 (United Nations, 1989), which were then incorporated into the pillars of sustainable development in 1992 (Agenda, 2030). Subsequently, in 1996, the initiative for a child-friendly space (CFS) was launched, combining the concepts of sustainable development and children's rights into a single definition: ‘shaping urban life that meets the needs of children and young people through active and participatory planning processes, without compromising the needs of future generations.’(Hadfield-Hill, 2019).

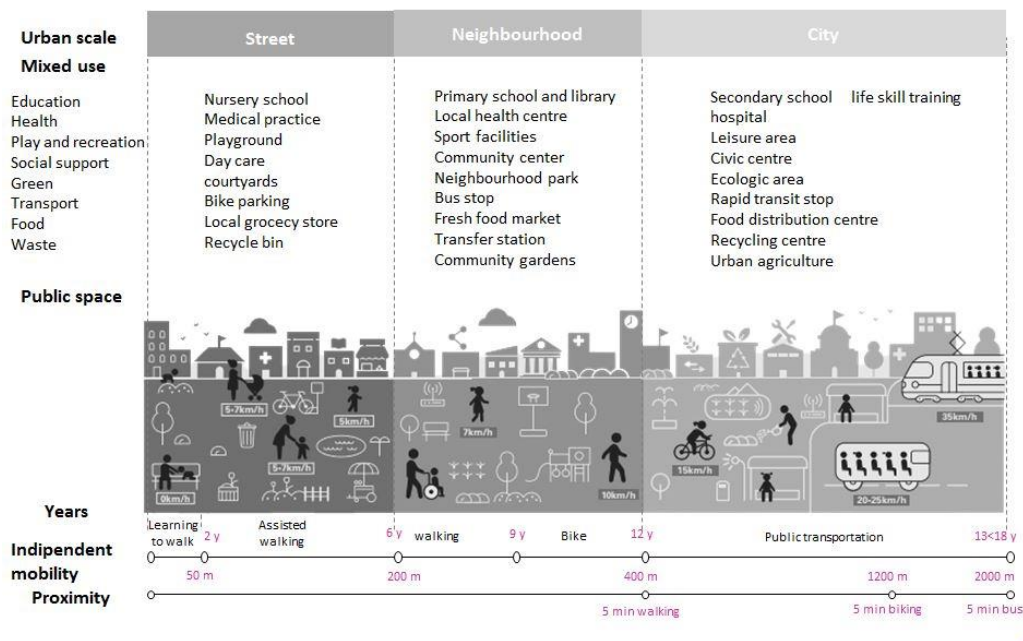


Figure N° 01: Space and scale of urban childhoods. (Source: Aerts, J., 2018)

According to Germanos, the integration of children in urban space is a spatio-cultural problem that combines tangible parameters linked to the characteristics of the space and intangible parameters linked to the modalities of use of this space in which the daily reality of a given society unfolds (Germanos, 1993). By projecting this definition into the context of the school environment, a child-friendly school zone is a space designed according to sustainable children's standards, guaranteeing functional, appropriate, safe and autonomous use, allowing normal or disabled children to develop physically and cognitively in a resilient and participatory climate. According to Sulaiman and Ibrahim (2019), young children's exposure to the school environment provides an opportunity for children to develop and advance their skills and understanding of concepts and the world around them (Sulaiman & Ibrahim, 2019).

Scientific research focusing on the school environment and home-to-school journeys has received a great deal of interest from researchers. A wide range of disciplines has been covered, including studies on children's safety (Lamari, & Lazri, 2021), their health (Wong, Parikh, et al. 2016), their mobility (Masoumi, Rooijen, et al. 2020), their outdoor behavior (Huguenin-

Richard, 2010), as well as parental attitudes (Godillon, & Cloutier. 2019) and the suitability of the physical environment (Habsah, SITI Fatimah, et al. 2019). In this respect, the area around the school, as a public space, plays a major role in the daily life of thousands of citizens, namely pupils, their parents and school staff (Willemen, Mercier, et al. 2022). The design and the planning of a public space can promote the practice of certain activities or, on the contrary, restrict it (Voisin-Bormuth, 2019).

Among other aspects of public space, street furniture in turn makes an important contribution to improving the quality of urban space. It also represents the local identity of the area in which it is located (Spangenberg, 2013). The design, implementation and maintenance of this element at the user level are decisive factors that improve the users' interaction with these public spaces on a daily basis (Cengiz, Karaelma, et al. 2018). Street furniture evolves according to human needs. Its development has gone through several stages with several concepts, namely design and manufacturing with a focus on user needs, environment and sustainability, and preservation of ecological resources (Song, & Bao, 2022; Yang, 2023; Feng, & Xia, 2014). With the advancement of technology, urban furniture is becoming more intelligent, allowing it to create different functions in urban spaces while adapting to their requirements and characteristics (Humphry, Maalsen, et al. 2022; Premier, Ghaffarian-Hoseini, et al. 2022).

Thinking about the design of street furniture for children is an attempt at their inclusion in the urban space. In order to improve the quality of the school environment, it is appropriate to think in terms of children's perceptions, ensuring safety and access to a welcoming, distracting and recreational environment and favorable conditions for children's development (Willemen, Mercier, et al. 2022). The creative intervention of young users and their participation in the design of urban furniture was a strategy acquired by scientific researchers in order to have an intergenerational space (Dingwei, Tanghao, et al. 2023). The design of this micro-element will have to meet several conception criteria such as functionality, ergonomics, aesthetic character, shape, material, color, texture and perceptibility must be taken into consideration (Karaca, M., Altiparmakoğullari, et al. 2023). It should be designed to take into account the choice of sustainable and environmentally friendly materials, ease of maintenance, and use of economic resources, product functionality, cost effectiveness, recycling and protection against vandalism (Kılıç and Sungurlu, 2021).

In this context, this study aims to analyze the relationship between children's mobility and the street furniture surrounding urban school 'Tarek Ibn Ziad' in Guelma, by checking whether this micro-element meets the needs of schoolchildren in these urban spaces, while respecting the guidelines of 'child-friendly design' based on sustainability, ecology and technological progress. This research will contribute to make children aware of their rights as key users of the city; and to support local elected representatives in making decisions through a flexible and participatory process.

2- Theoretical framework

Since the emergence of the notion of sustainable development in 1992, the program has been modelled to incorporate the needs of humanity in a sustainable way. The urban child, as a vulnerable stakeholder, needs careful planning that integrates children's rights (Cloutier and

Torres, 2010). Child Friendly Design, one of the concepts, has been created to cover a wide range of issues aimed at improving the child-space relationship while adapting to children's current needs, which change over time (UNICEF, 2022).

Going to another scale, the vocation of urban furniture is to make life and the use of public spaces easier in cities where pedestrianisation and densification have become increasingly common in recent decades (A'urba, 2021). It has evolved throughout its existence to meet the changing needs of individuals and urban communities. Urban furniture dates back to antiquity, when the oldest civilizations in antiquity, the Middle Ages, the Renaissance, the modern era, the 20th century and the 21st century implemented public spaces that simultaneously evolved and diversified according to the progressive functions of the city (Song and Bao, 2022).

Furniture design was based on decorative and artistic considerations (columns, fountains, benches and monuments). In the industrial era, furniture design focused on functionality and the integration of technological advances, which affected urban furniture through the introduction of public lighting and the creation of street lamps (DeJean, 2017), public benches and shelters to ensure the comfort of citizens and protect them from storms. In the 20th century, due to population growth, the accelerated expansion of urban areas and the multiplication of motorized travel, the demand for urban furniture increased and diversified (Song and Bao, 2022). Bus shelters, traffic signs, car parks, street hierarchies and other facilities were installed to meet purely quantitative needs that were not carefully planned. In the 21st century, modern street furniture aims to be both practical and aesthetic at the same time (Karşlı and Öztürk, 2019). Designs have become centred on durability, ergonomics and energy efficiency. Innovative technologies such as electric charging stations and smart bus shelters (Keçecioglu Dağlı and Özdemir Durak, 2022) are also being integrated to strengthen the relationship with space.

The area surrounding schools is an important living space, especially for pupils, but also for school staff, parents and other school users. Putting the child's perspective at the center of its concerns, a school zone must be suitable in terms of safety, comfort, accessibility and durability for all users, especially schoolchildren (Willemen, Mercier, et al., 2022). In the same context, urban furniture makes it possible to mark pedestrian paths, structure parking areas and make the space safer for everyone (Guyon, 2022). Outdoor furniture is therefore closely linked to children's mobility and motorized mobility. The intention is not to impose uniform planning and furniture, but to encourage harmonization in the design and installation of street furniture (A'urba, 2021).

In terms of mobility, school arrival and departure times (peak hours) generate a large number of journeys by foot, bicycle, public transport, school bus and car (Demers, 2006). In addition, accompanied children show more risky behavior (not stopping, not looking both sides before crossing, crossing when a vehicle is approaching, running to cross, etc.) (Rosenbloom et al., 2008). Therefore, many parents feel a great deal of anxiety (Lamari and Lazri, 2021). As a result, the behavior of accompanied children is more disturbed than that of unaccompanied children (Burigusa, 2011). Lynch (1977) and Freeman and Quigg (2009) have shown that users' knowledge of their urban environment, particularly those of children, is perfectly correlated with their effective use of that space. In terms of health, in its 2010 report, the US Department of Health and Human Services affirmed the importance of physical activity by setting two objectives (22.14 and 22.15) aimed at promoting active travel (Evenson, Neelon et al., 2008),

likely to enable adequate cognitive, relational and spatial-physical development (Rudner and Malone, 2011) and prevent overweight and obesity (Tudorlocke, Ainsworth, et al., 2001). Despite the advantages of autonomy, a welcoming and legible environment is indispensable to enable individuals to acquire skills (Prezza, Alparone, et al., 2005). In this respect, scientific researchers have shown great interest in exploring the relationship between the child and the urban world through multi-criteria analyses covering numerous topics incorporated into the concept of ‘child-friendly design’ (Kyttä, 2003; Habsah et al., 2019), affirming the strong correlation between the physical environment and the child's behaviour when moving around. Other researchers have focused on the components of urban spaces, such as urban furniture and its essential role in improving the quality of public spaces (Siu et al., 2015; Keçecioglu Dağlı & Özdemir Durak, 2022; Dhaou et al., 2022) without addressing the notion of childhood. Several guides have been developed with the aim of creating a child-friendly environment, particularly around schools, where sustainable issues and objectives have been fixed (Willemen, Mercier, et al., 2022).

The present study examines a sensitive case relating to the surroundings of a primary school. It aims to combine several concepts, namely ‘street furniture’ and ‘children's mobility’ under the aegis of ‘child-friendly design’, in order to assess the suitability of this micro-element for children's use and its impact on their mobility and travel behavior. The assessment will be based on sustainable objectives taken from scientific studies, sustainable design guides and UNICEF documents. These will then be adapted to our context of school surroundings and organized in the form of a multi-attribute hierarchical tree. The following table shows the source of each objective that will be used in the evaluation process.

Table N° 01: The source of information of each objective. (Source: Authors, elaborated from several data)

	objectives	Source of information
Attributes	- A safe and accessible school surroundings for children - Others requirements such as activity allocation, accessibility, safety	- Willemen, Mercier, et al., 2022 - Didier , 2010 - Dhaou & Vasvary-Nador, 2022
	- A distinctive school surroundings	
	- Aesthetic and functional design for school zone	
	- Intelligent and sustainable school surroundings	- Aerts, 2018 - Özdemir & Öztürk, 2017
	- Health and social well-being - Comfort and quality of life - Living conditions, social structure	- Keçecioglu Dağlı & Özdemir Durak, 2022 - Dhaou and Vasvary-Nador, 2022
Variables ‘A’	- Regulatory signs	- Didier, 2010
	- Pedagogical signs	
	- Harmonized Furniture	
	- Hierarchical planning	
Variables ‘B’	- Visibility of school and its entrance	- Didier, 2010
	- Call points and land mark	
	- Perceptible urban furniture	- Karlı and Öztürk, 2019

	- Sensory stimulation	- Rathod & Wagner, 2021; - Degen & Rose , 2012
Variables 'C'	- Design of urban furniture (shape, color, texture, conception, dimensions...) - Implementation of urban furniture - Maintenance of urban furniture	- Cengiz et.al., 2017 - Siu and Wong, 2015
	- Functional Urban furniture (positioning, etc.) - Aesthetic urban furniture	- Karşlı & Öztürk, 2019
	- Minimizing maintenance resources	- Dhaou & Vasvary-Nador, 2022; Sewandono, 2022
	- Sufficient flexibility of urban furniture to adapt change as needed - Adequate anthropometry	- Siu & Wong, 2015
	- Recyclable materials - Sustainable products	- Karşlı and Öztürk, 2019 - Sewandono, 2022 - Karşlı & Öztürk, 2019
Variables 'D'	- Smart urban furniture	- Qin, 2022; Humphry et.al., 2022; Yang et.al., 2022; Özgüç Erdönmez & Aslan, 2017; Najafidashtape, 2018
	- Environmentally friendly production technologies	- Aerts, 2018
	- Ecological urban furniture	- Keçecioglu Dağlı & Özdemir Durak, 2022
	- the efficiency of urban furniture	- Song & Bao, 2022
	- Identity and urban image - socio-cultural identity (cultural sustainability)	- Dhaou & Vasvary-Nador, 2022 - Keçecioglu Dağlı & Özdemir Durak, 2022. - Najafidashtape, 2018; Özgeriş, 2018; Ertaş, 2017 - Song & Bao, 2022
Variables 'E'	- Promoting awareness production and use of sustainable furniture	- Keçecioglu Dağlı & Özdemir Durak, 2022
	- Social equality	- Aerts, 2018
	- Socio-physical development of child	- Dermanos, 1993
	- Children's participation	- Aerts, 2018
	- Cognitive and relational development	- Rudner & Malone, 2010

3-Methodology

In order to achieve the objectives of this research, a methodological process is described, consisting of five (05) complementary phases, respectively corresponding to:

3-1- Creation of an attribute hierarchy tree

Due to the systemic nature of our initial issue of urban furniture, the multi-attribute analysis method was chosen because of its flexibility in prioritizing the attributes and variables of furniture surrounding school in order to assess the performance of this micro-element. Taking into account several aspects from theoretical documents (UNICEF documents, guidelines on the school environment, the Convention on the Rights of the Child, scientific research, etc.) and integrating the triangulation of 3 concepts: the sustainability aspect, the technological aspect and the socio-physical aspect linked to the concept of 'child-friendly design'. The model will be

used for an ex-post evaluation to develop a diagnosis based on the performance achieved. Based on the theoretical framework, an evaluation tree for urban furniture surrounding schools is designed according to sustainable objectives and children's needs (Figure 02):

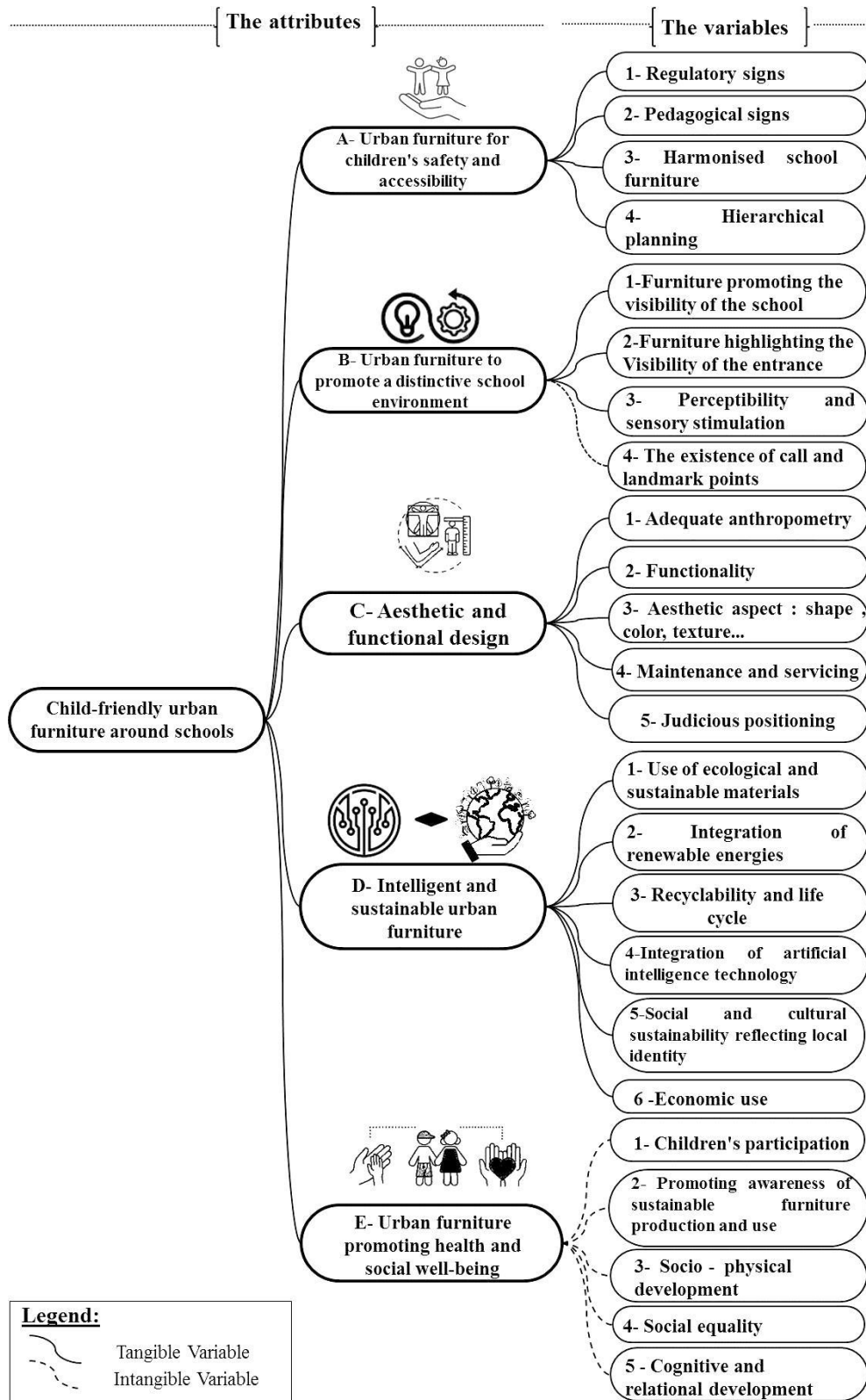


Figure N° 02: Multi-attribute evaluation tree for urban furniture around schools. (Source: Authors based on different sources, 2023)

3-2- Case study

The surroundings of the urban school ‘Tarek Ibn Ziad’ were selected as a case study. This urban school is located in the city center of Guelma, Algeria (36° 27'43 N; 7° 25'33 E; 840 m altitude). It was chosen for its strategic location and its physical and systemic characteristics, which include urban phenomena (mobility, urban activities in the surroundings, etc.). The specific objective of this research was to evaluate the urban furniture around the school and its impact on pupils' mobility. To this end, spatial boundaries were defined, followed by an inventory and a school survey to collect quantitative and qualitative data:

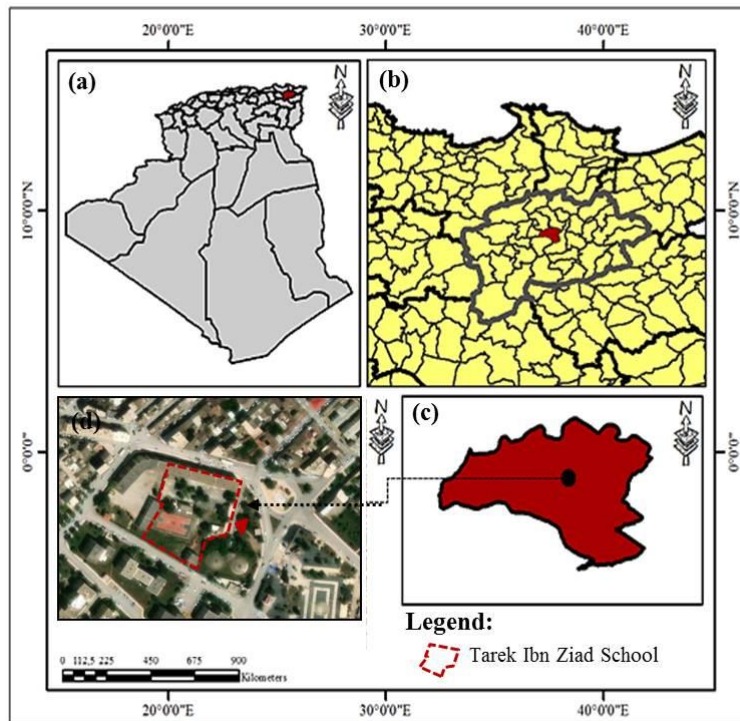


Figure N° 03: Geographical location of the area surrounding Tarek Ibn Ziad School; (a) national scale (b) regional scale (c) municipal scale (d) the urban school. (Source: Authors, 2023)

- Delimitation of the study area:

The spatial scale of the area surrounding the school cannot be strictly defined; it varies according to the location of the school, its context and the space available. In an urban context, the area surrounding ‘Tarek Ibn Ziad’ school is limited to a relatively small zone; the surrounding buildings, the roads, the adjacent pavements and the junction, together represent the immediate surroundings of the school. This perimeter is conditioned by the built environment characteristics, existing activities and urban phenomena (pedestrian flow, mechanical flow, etc.) where users, especially pupils, react differently when entering and leaving the school.

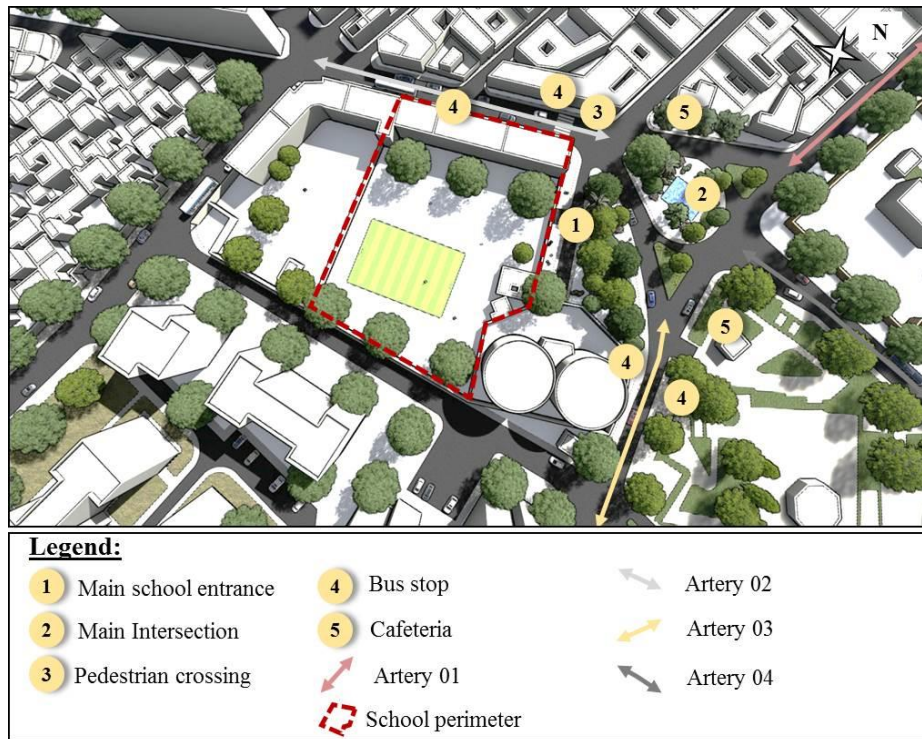


Figure N° 04: Ground plan of 'Tarek Ibn Ziad' urban school. (Source: Authors, Based on a street map from the archives of the municipal public authorities of Guelma)



Figure N° 05: 'Tarek Ibn Ziad' urban school after rehabilitation. (Source: Lamari & Lazri, 2021)

3-3- On-site inventory and Data collection

An on-site inventory was carried out over two (02) weeks (March 2021) with the aim of evaluating the urban furniture in the surroundings of the selected school using a multi-criteria analysis. The implementation of this consists of an assessment based on a checklist containing all the elements of urban furniture mentioned in the tree of attributes, which takes into account: safety and accessibility for children, suitability for children, landscape and sensory stimulation, sustainability and integration of intelligent technologies, as well as children's behaviors. The inventory will be used on the surroundings of school to collect photographic documentation, the necessary spatial characteristics in terms of urban furniture and their impact on schoolchildren's

mobility behavior. It serves as an argument to strengthen the findings of the AHP analysis. Other data will be collected from administrative documents relating to external planning and mobility to better distinguish and explore the phenomena covered by the study.

In terms of street furniture, the area around the ‘Tarek Ibn Ziad’ school is characterized by:

- A hierarchy of pedestrian and mechanical space (pavements and roadways), but schoolchildren are marginalized because the furniture (bollards, barriers, etc.) that regulates pedestrian flow in the surroundings of the school is completely absent.
- The existence of a main junction just a few meters from the entrance.
- The existence of 04 urban transport stops that do not meet child-friendly design standards.
- The absence of a well-structured car park, leading to uncontrolled stopping.
- The lack of parking signs.
- The absence of pedestrian or children's crossing signs indicating an area around the school.
- The lack of road signs to reduce speed despite the intensity of the traffic.
- The presence of lampposts properly positioned.
- The presence of a pedestrian crossing.
- Scattered trees and shrubs that restrict visibility of the main entrance to the school.
- The absence of furniture for children to rest and play on.
- The existence of wall drawings offering a cultural identity.
- Disabled children are totally excluded by the existing planning (absence of ramps).
- The distinct color of the school.
- The presence of landmarks.
- The notions of sustainability and intelligent technology are totally absent.

In general, the existing design is not harmonized. It marginalizes the majority of outdoor school furniture and the child as the main user of this zone. Consequently, there is no appropriate interaction with the physical space.



Figure N° 06: (a) Pupils playing at the junction, (b) Illegal parking of pupils' parents, (c) Lack of barriers to separate different flows, (d) The phenomenon of accompanying children. (Source: Authors, 2023)

In terms of mobility, the summary of the revised study of the new traffic plan for the city of Guelma (2015) highlights the junction of 'Bab Essouk' as an area of enormous potential conflict between vehicles and vehicles/pedestrians, making it a particularly dangerous place for accidents. As a result, particular attention has been accorded to this junction, which has been selected and investigated in cooperation with the technical services of Guelma Transport Authority. It has been characterized by:

- An enormous motorized flow of more than 17,868 vehicles.
- An unbalanced and unchannelled flow of pedestrians on the different branches of the junction, instantly generating mixed conflicts (2437 pedestrians cross the intersection, including children).

It is therefore recommended that the existing situation should be improved to ensure the safety of pedestrians, especially children. The aspect of road safety in the immediate area around schools requires all school infrastructures and facilities to be subject to an expert assessment in terms of the development of spaces that need to be preserved to ensure the safest possible conditions for the school population in the immediate area around primary establishments located in the various zones of the Guelma city (*CECOM-CIRTA & DTW Guelma, 2015*).

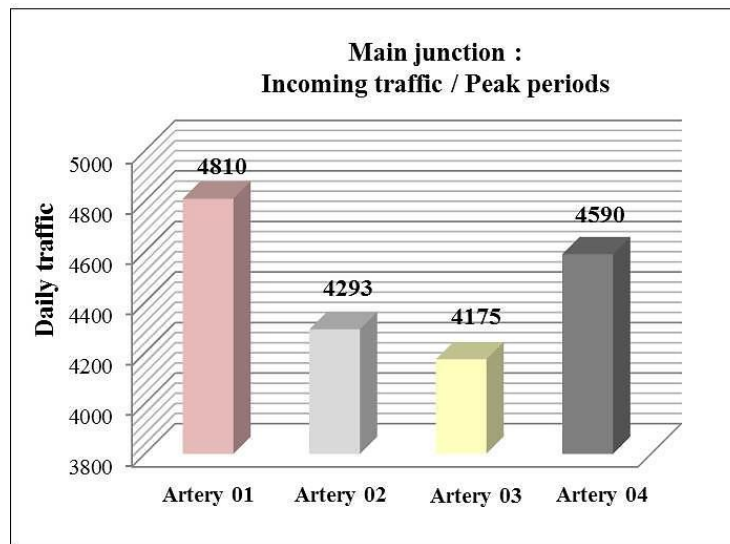


Figure N° 07: Traffic flow for the main road intersection. (*Source: CECOM-CIRTA & DTW Guelma, 2015*)

The data collected confirms the dangerous situation in the surrounding of the primary school. The lack of street furniture and the poor design of the school zone have an impact on children's daily lives. As a result, uncontrolled behavior on the part of pupils who run on the roads, do not check both sides before crossing, sometimes cross as a vehicle approaches, run to cross and do not feel comfortable while crossing, and other dangerous behavior. Parents feel extremely anxious. This is clearly seen in the daily accompaniment of their children to ensure their safe arrival to and from school. Non-autonomous mobility and unsuitable physical conditions do not allow children to develop cognitively and relationally so that they can acquire new skills through direct interaction. This leads to other problems in terms of health, social and environmental issues, etc.

3-4- School survey by questionnaire

The target group for the questionnaire survey was 137 pupils from 'Tarek Ibn Ziad' Primary School, aged between 6 and 12 years. The school survey was carried out for one month (April 2021) and consisted of several sections based on the attributes mentioned above, covering the concept of street furniture combined with several other concepts, namely sustainability, technology and child-friendly design. The questionnaire had to be adapted to the evaluation and comparison scale (Likert scale) below in order to obtain accurate quantitative and qualitative data to assess the performance of this micro-element and its suitability for children, as well as its impact on their mobility and autonomy. The participation of children is a crucial task that allows us to analyze their behavior through their relationship with the elements of the school environment, including urban furniture, and to make them aware of their rights in relation to urban space, sustainability and compatible technology from an early age and through educational means, in order to have a child that promotes the principles of sustainability and resilience.

3-5- Performance assessment of urban furniture around the school using AHP process

Hierarchical Process Analysis (AHP) developed by Professor Thomas L. Saaty in 1970 (Saaty, L., 2008), is a method for analyzing complex decisions. It is widely used in several fields, including urban planning, project evaluation and management, etc. because of its flexibility in assessing problems of a systemic nature. It was chosen for the weighting phase and the performance calculation based on the hierarchical tree of attributes and variables (Figure N°02). The following table shows the different steps of the AHP process:

Table N° 02: Hierarchical Process Analysis (AHP) process. (Source: Authors, Adapted and elaborated from several data)

Steps	Description
1- Building an attribute hierarchy tree	- Prioritization and formulation of an evaluation tree for urban furniture around schools based on several objectives derived from theoretical documents (UNICEF documents, guides on school environments, the Convention on the Rights of the Child, scientific research, etc.) and aligned with the notion of sustainable Child-Friendly Design.
2- Determining an assessment and comparison scale	- Establishment of a comparative scale to assess the relative suitability of street furniture between attributes and sub-attributes. This scale is usually based on a numerical coding from 1 to 7: 1- Very unsuitable for the child and its mobility, 2- Unsuitable for the child and its mobility, 3- Slightly unsuitable for the child and its mobility, 4- Neither suitable nor unsuitable for the child and its mobility (neutral), 5- Slightly suitable for the child and its mobility, 6- Suitable for the child and its mobility, 7- Very suitable for the child and its mobility.
3- Pairwise comparison	- On the basis of the school survey data and the selected comparison scale, the attributes and sub-attributes are compared in pairs using comparison matrices. - According to Saaty, 2008, the relative weights of the attributes and sub-attributes are calculated using the eigenvalue method.

	<p>(Equation 1)</p> $\lambda_{\max} = a_{ij} \frac{W_j}{W_i}$ <p>λ_{\max}: the eigenvalue a_{ij}: The judgement matrix for the value of the element (i) in the ith row and the element (j) in the jth column. W_j: The contribution to the selection of the best choice and to each of the variables. W_i: The contribution of specific variables to the main objective.</p> <p>Then, the performance values will be normalized using Z-score formula (Abdi, 2007) to facilitate the processing and comparison of the results. (Equation 2)</p> $Z = \frac{Y - M_y}{S_y}$ <p>Y: The raw index value M_y: The median reference value S_y: The Standard deviation of referential sample</p>
<p>4- Verification of coherency=</p>	<p>- Given that children may be uncertain and unaware of their urban rights or may make inaccurate judgements between variables, the validity of decisions is checked using consistency index (Equation 3).</p> $IC = \frac{\lambda_{\max} - n}{n - 1}$ <p>n: Number of variables</p> <p>- The consistency of the comparison matrix is assessed using the consistency ratio RC (equation 4).</p> $RC = \frac{CI}{AI}$ <p>$RC \leq 0.1$, CI: consistency index value, AI: aleatory index value</p>

4-Results and Discussions

4-1- Performance assessment of urban furniture around the school using AHP process

By applying the AHP analysis process described above (Table N°02) to the objective of assessing the suitability of street furniture for children's use and its impact on their mobility and their behavior using school survey data, we obtained performance values for each variable in the hierarchical tree. The average between the variables in each branch was used to obtain the attribute performance score. It should be noted that the weighting given to each variable is the average value obtained from the school survey data.

The overall consistency ratio is equal to 0.08 (8%), which is considered as acceptable, indicating the consistency of the pairwise comparison results.

- Pairwise comparison:

The majority of performance standardized values resulting are grouped into 04 intervals: a mediocre performance interval, a weak performance interval, an average performance interval and a good performance interval.

A- Urban furniture for children's safety and accessibility:

Table N°03 and Figure N°08 contain the results of ‘the urban furniture ensuring children's safety and accessibility’ attribute, it consists of the following:

Table N°03: Pair-wise comparison matrix of performance values of ‘urban furniture for children’s safety and accessibility around schools’ attribute and its variables

Variable	A-1	A-2	A-3	A-4	Performance value	Standardized value
A-1	1.00	0.66	0.42	0.22	0.10	- 0.67
A-2	1.67	1.00	0.67	0.33	0.16	- 0.30
A-3	2.67	1.67	1.00	0.50	0.25	0.24
A-4	4.67	3.33	2.00	1.00	0.49	1.71
Sum of values					1	0.98
Mean value					0.25	0.25
$\lambda_{\max} = 4.12$		IC = 0.04		RC= 4% (acceptable)		

- Urban furniture of ‘Regulatory signs’ (A-1) took a mediocre score equal to - 0.67, revealing that the surroundings of ‘Tarek Ibn Ziad’ school are devoid of road signs (On-site inventory and Data collection section). This had a significant impact on pupils' behaviors and mobility. The absence of urban furniture of regulatory signs such as road signs, pedestrian crossing signs and traffic lights make the school environment unsafe for children. They were not able to cross the road easily to get to school. As they are exposed to dangerous conditions. This is reflected in the anxiety of parents accompanying their children (Lamari & Lazri, 2021) and contributes to aggravating the problem of motorized traffic. This situation is confirmed by the Synthesis of the City's Transport Plan, which highlights the density of traffic at the junction (see Figure 06) and the urgent need to remedy the lack of road signs to moderate and organize traffic flows (CECOM-CIRTA & DTW Guelma, 2015). Poor signage made it difficult for children to understand how to behave as pedestrians and to respect the traffic rules. In order to improve performance and encourage autonomous mobility, the integration of regulatory signs can play an educative role, instructing children in traffic rules and encouraging independent mobility through walking or cycling. A school environment organized using road signs can increase the visibility of children, or drivers themselves can predict the unpredictable movements of children. This signs can include speed limit signs, barriers, traffic lights and other measures to improve children's safety. It is also important to educate pupils about the road rules and promote active travel.
- The 'Pedagogical signs' (A-2) variable obtained a negative performance of -0.30, demonstrating that there are almost no pedagogical signs in the surroundings of the selected

school. This is clearly demonstrated by the irresponsible displacement behavior of pupils on pavements and roads due to driver's behaviors. To remedy the problem, educational signs need to be carefully installed. They can raise awareness and inform schoolchildren about the precautions they need to take around school and about good traffic practices by limiting reckless behavior (crossing the road without being careful, running on the pavement or ignoring traffic rules). A welcoming school approach should have educational signs so that schoolchildren can interact properly with their physical environment by slowing down, stopping at pedestrian crossings and adopting a cautious attitude. This kind of layout can encourage autonomous and sustainable mobility to school.

- The variable 'Harmonized school furniture' (A-3) obtained an average performance of 0.24, reflecting an average suitability of the existing furniture. The area around the primary school is not sufficiently harmonized in terms of street furniture, as most of it is non-existent. As a result, the area has become unsafe and unsuitable for children's mobility. In order to improve performance, it is necessary to use this micro-element to help reduce the dangers for schoolchildren by providing facilities adapted to their needs (such as well-marked pedestrian crossings, traffic lights, speed bumps and green meeting spaces, wide pavements, access ramps and separating cycle paths, etc.) to improve their safety, accessibility and comfort when waiting for or walking around school. At the same time, it encourages families to reduce their anxiety and opt for active modes of transport. Harmonized street furniture can indirectly help to make drivers aware of the presence of school zone. In this respect, the involvement of the community, pupils, parent- associations, teachers, local elected representatives and the school itself is necessary to foster a sense of belonging and responsibility towards children through a suitable space.
- The 'hierarchical planning' variable (A-4) obtained a good performance value of 1.71, revealing that the hierarchy of pedestrian and mechanical space is good in relation to the existing urban tissue characteristics around the primary school. It classifies the space according to the type of user (pedestrian, mechanized). This variable is closely linked to the users' mobility, particularly children, by managing pedestrian and mechanical flows and creating a hierarchical environment for pupils to move around the school. From on-site observations, it appears that this hierarchical planning has not perfectly ensured the safety of pupils, who are always accompanied due to road dangers. To achieve more adequate levels of safety, pedestrians and cyclists should be given greater priority, with connected and safe routes to guide their flow around the school using traffic lights, speed bumps, fixed barriers, etc. To improve accessibility, the emphasis should be on autonomous active mobility, including disabled children, which will have a positive impact on pupils' behavior by encouraging them to choose more sustainable and healthier modes of transport. This can reduce traffic congestion, greenhouse gas emissions and improve air quality, and create a healthier environment for pupils.

The overall value of the attribute 'Street furniture for children's safety and accessibility' is equal to 0.25, synonymous with an average performance highlighting a state that requires improvements in terms of street furniture guaranteeing children's accessibility and safety in the surroundings of the chosen school. These improvements can therefore affect their behavior in

terms of mobility and reduce parents' feelings of anxiety by paying particular attention to the 4 variables mentioned above, which are in line with careful planning and design of furniture in accordance with the concept of child-friendly sustainable design (Table N°03, Figure N°08).

B- Urban furniture promoting a distinctive school surroundings:

Table N°04 and Figure N°08 show the results relating to the urban furniture that promotes distinctive school surroundings for children's, it includes the following items:

Table N°04: Pair-wise comparison matrix of performance values of 'Urban furniture promoting a distinctive school surroundings' attribute and its variables

Variable	B-1	B-2	B-3	B-4	Performance value	Standardized value
B-1	1.00	0.50	0.25	0.17	0.08	- 0.79
B-2	2.00	1.00	0.50	0.25	0.16	- 0.30
B-3	4.00	2.00	1.00	0.50	0.28	0.43
B-4	6.00	4.00	2.00	1.00	0.51	1.83
Sum of values					1	1.17
Mean value					0.25	0.29
$\lambda_{max} = 4.03$		IC = 0.01		RC= 1% (acceptable)		

- The variables of 'Furniture promoting the visibility of the school' (B-1) and 'Furniture promoting the visibility of the school entrance' (B-2) obtained a mediocre and poor values of - 0.79, - 0.30 respectively indicating that the existing urban furniture does not provide better visibility of the school and its entrance. This makes children's not able to find their way by means of attractive physical elements. This state lead to irresponsible behavior when they are moving around. In addition, parents contribute to the problem through their use of motorized traffic by stopping at the main entrance of the school. To increase visibility, improving physical attributes of visibility (such as well-designed luminous or architectural elements, road markings on the entrance and around school, etc.) is a necessity that can support educational messages and positively influence pupil behavior. On the other hand, they can also dissuade parents from driving their children to school and encourage pupil's autonomous mobility. Having a clear view of the entrance and the establishment makes it easier for motorists, cyclists and pedestrians to spot the school, therefore reducing the risk of accidentology, particularly at peak times.
- The 'Perceptibility and sensory stimulation' (B-3) variable had an average value of 0.43, reflecting the average adequacy of the existing urban furniture around the school. The lack of street furniture makes the space less perceptible, which does not stimulate curiosity and exploration on the part of the children. They not have sufficient and appropriate experience to interact and move around the school correctly. Non-stimulating and non-perceptible furniture does not allow children to be guided and oriented safely. The school's surroundings are deprived of Clear signage, bright colors, distinctive pavement markings and an effective layout of street furniture all contribute to making the school environment less comprehensible to children. In a safety context, shortcomings in terms of perceptible

elements of street furniture, such as well-marked pedestrian crossings, traffic lights, speed reduction measures and meeting zones, worsen the problem of road unsafety. The area around the school does not provide street furniture that could educate children to respect traffic rules. To improve the situation, the perceptibility dimension of street furniture can help children find their way, with clear signs indicating the school entrance and the school zone in general. In addition, stimulating and perceptible furniture provokes the child's senses in a positive way by improving the socio-physical link, i.e. tactile and visual stimulation (trees, plants, colored furniture) as well as creativity and imagination (monuments and works of art)... etc. Participatory design that includes children can help to create furniture that is adapted to their needs and contributes to effective interaction and autonomous movement for their healthy development.

- The variable 'the presence of call points and landmarks' (B-4) obtained a good performance value of 1.83, indicating that the surroundings of the selected school are enriched by various call points and landmarks that promote an identifiable school environment for children. The selected school is located in an urban area rich in historical elements (such as monuments, Byzantine enclosures, and other historical buildings). Those elements significantly influence children's mobility attitudes. They enhance children's safety and confidence when moving around the school. This kind of urban furniture enables them to learn about its spatial functioning and the relationship between its components, such as pedestrian crossings, bus stops, meeting points and other reference elements, which helps them to avoid potential dangers, feel safe, find their way around easily and in an active and autonomous way. They also develop social and spatial skills in relation to their peers and their environment. To fortify performance and drive it towards sustainability, call points and landmarks can play a self-disciplining role through messages promoting sustainable practices such as active mobility, environmental conservation, children's participation, etc. in order to have a generation that promotes sustainability.

The total value of 'Urban furniture promoting distinctive school surroundings for children' attribute is equal to 0.29, which is synonymous with an average performance, highlighting the fact that the existing urban furniture does not sufficiently provide a distinctive school environment for the majority of pupils. This state influences how they behave when trying to move around school. In order to improve the distinction of this area by means of urban furniture, the implementation of other types of appropriate urban furniture to the school's surroundings that promote visibility of the establishment, pupils' perception, stimulation and relationship to their immediate environment is needed (Table N°04, Figure N°08).

C- Aesthetic and functional design of urban furniture:

Table N°05 and Figure N°08 present the results relating for the Aesthetic and functional design of urban furniture' attribute and its variables, and is made up of the following points:

Table N°05: Pair-wise comparison matrix of performance values of 'Aesthetic and functional design of urban furniture' attribute and its variables

Variable	C-1	C-2	C-3	C-4	C-5	Performance value	Standardized value

C-1	1.00	0.58	0.42	0.92	0.18	0.08	- 0.79
C-2	2.33	1.00	0.83	0.50	0.25	0.12	- 0.54
C-3	2.67	1.33	1.00	0.66	0.33	0.15	- 0.37
C-4	4.00	2.00	0.22	1.00	0.50	0.19	- 0.12
C-5	6.00	4.00	3.33	2.00	1.00	0.45	1.46
Sum of values						1	- 0.36
Mean value						0.2	- 0.07
$\lambda_{\max} = 5.38$			IC = 0.095		RC= 8% (acceptable)		

- A mediocre performance equal to -0.79 was obtained for the 'adequate anthropometry' variable (C-1), revealing that the existing street furniture around school did not take into account of children's physical characteristics (their size, strength and mobility), which constrained the use of space, given that street furniture is considered to be a moderating factor in children's attitudes in terms of movement around the school. The absence of most of the urban furniture necessary for children's basic activities has led to other shortcomings, such as poor accessibility, insecurity, a feeling of unease and anxiety on the part of children and the parents who accompany them to school. As a result, the majority of pupils live in a climate of discomfort and marginalization in terms of spatial planning. To improve the situation, taking anthropometric design into account in the process of designing and installing furniture can play a decisive role in encouraging children's positive attitudes towards active travel around school. By creating a safe, accessible, comfortable, stimulating and friendly environment, children can be encouraged to walk, cycle or use other active modes of transport to get to school, with numerous benefits for their health, well-being and the environment.
- A poor performance of -0.54 was recorded for the variable 'Functionality of existing urban furniture' (C-2), showing that this micro-element does not function appropriately for children around the school. The lack of road signs, educational signs, play and sports furniture, and the poor layout of the various surrounding facilities lead to serious malfunctions, namely a conflict between pedestrian and mechanical flows, transforming the school zone into a transit zone for entering and leaving the school. As a result, pupils spend only a few minutes in front of the school before leaving it accompanied by their classmates or adults. This affects their intellectual development and their relationships with space and other people. To improve this situation, careful participatory planning is essential to ensure a transparent decision-making climate and a welcoming space for current and future generations.
- A negative performance value equal to - 0.37, showing that the variable 'aesthetic aspect' (C-3) of the existing urban furniture around the school does not fulfil its role with regard to children's activities, behavior and movements. Only a few elements are present, such as lampposts, several transport stops, a pedestrian crossing that is not well marked, a few scattered trees, and wall drawings. Children are not sufficiently attracted visually by the existing elements, which does not encourage them to move around actively. To improve their experience, they need to be encouraged to explore the area around the school by means of colorful benches, artistically designed information panels, murals or attractive

landscaping, taking into account their safety and well-being. An aesthetically pleasing school environment can help make children's journeys more attractive by stimulating their creativity and strengthening their sense of belonging. This in turn encourages them to gather, play, interact and move independently.

- The variable 'Maintenance and servicing' (C-4), scored a mediocre performance value of -0.12, revealing that the area around the school is not subject to regular inspection of urban furniture in order to identify damage, deterioration or to install other missing elements such as benches, litter bins, play furniture, information panels, traffic calming devices, etc. in order to ensure the safety, functionality and aesthetics of the area around the school. However, some of the paving stones are in poor condition, others are dirty and the bus stops have been vandalized. These weaknesses are all detrimental to the children's experience of interaction and movement. To avoid problems, it is essential to maintain, clean and monitor the furniture to combat vandalism and limit the risk of falls and injuries to schoolchildren. Preventive measures can regulate the situation in the long term, such as the installation of cameras, child awareness campaigns and community involvement, all of which can help to improve children's daily experiences so that they can move and interact safely.
- The 'judicious positioning of street furniture' (C-5) variable obtained a good performance value of 1.46, reflecting the fact that the existing street furniture is well positioned around the school (correctly positioned lampposts, bus stops away from the main entrance, identifiable wall designs, pedestrian crossings, etc.) so that these elements do not impede the movement of schoolchildren, allowing open space for pedestrians. However, this is not enough to create a child-friendly space, due to the absence of a number of urban furniture elements that serve the purpose of safety (road and educational signs, fixed barriers, parking areas, other pedestrian crossings, etc.), play (play areas, waiting areas), cleanliness (well-placed rubbish bins), and in line with the standards of child sustainability throughout the process.

The overall performance value of the attribute 'Aesthetic and functional design of urban furniture' is equal to -0.07, meaning a poor performance underlining that the existing urban furniture are not adapted to children's sustainable standards and to the design of the area around the school. Therefore, this situation has a direct effect on the child's mobility behavior. In order to improve the functionality and aesthetics of the area around the school by means of urban furniture, an appropriate design of these elements is therefore recommended, taking into account children's needs. Particular attention must be given to the child's anthropometric data, the aesthetic aspect of the furniture, and regular monitoring if maintenance is required, in order to guarantee safe use and autonomous mobility around the school (Table N°05, Figure N°08).

D- Intelligent and sustainable urban furniture:

Table N°06 and Figure N°08 present the findings for the 'Intelligent and sustainable urban furniture' attribute and its variables. The performance achieved can be grouped into 2 categories as follows:

Table N°06: Pair-wise comparison matrix of performance values of 'Intelligent and sustainable urban furniture'

attribute and its variables

Variable	D-1	D-2	D-3	D-4	D-5	D-6	Performance value	Standardized value
D-1	1.00	1.00	1.00	1.00	0.39	1.00	0.09	- 0.73
D-2	1.00	1.00	1.00	1.00	0.39	1.00	0.09	- 0.73
D-3	1.00	1.00	1.00	1.00	0.39	1.00	0.09	- 0.73
D-4	1.00	1.00	1.00	1.00	0.39	1.00	0.09	- 0.73
D-5	8.00	8.00	8.00	8.00	1.00	8.00	0.57	2.20
D-6	1.00	1.00	1.00	1.00	0.39	1.00	0.09	- 0.73
Sum of values							1	-1.45
Mean value							0.17	- 0.24
$\lambda_{\max} = 7.42$			IC = 0.28			RC= 23 % (inacceptable)		

- 5 out of 6 variables (D-1, D-2, D-3, D-4, D-6) obtained mediocre values equal to - 0.73 for the following urban furniture variables: use of ecological and sustainable materials, integration of renewable energies, recyclability and life cycle, integration of smart technology and economy of use. These results indicate the total marginality of the two concepts of sustainability and intelligence when designing and installing urban furniture on school environment which is therefore not subject to sustainable child-friendly design standards.

Unsustainable street furniture around the school is considered inappropriate because it does not provide a climate for sustainable interaction, particularly for children. The area around the school considered as a sensitive zone is devoid of intelligent and sustainable street furniture. This weakness has far-reaching repercussions, particularly for schoolchildren, as evidenced by the little time they spend in front of the school. These areas of social opportunity for children have become transit zones, and among the causes, they lack intelligent and sustainable furniture that encourages physical activity and enriches children's mobility experience, such as installations with motion sensors that encourage children to move around properly. To improve performance, mobility practices can be stimulated by interactive installations (pedestrian crossings with illuminated signs, attractive educational panels and rest furniture made from sustainable materials, lampposts equipped with movement sensors or monitoring systems, etc.) that encourage exploration and curiosity and thus contribute to children's health and well-being. Intelligent, sustainable design can educate children by raising their awareness of a number of concepts, such as the use of ecological and sustainable materials, energy efficiency, the use of renewable resources, and other concepts that serve to enhance their skills around school at present and their participation in sustainable practice in the future. Rich and safe environments in terms of urban furniture can foster a rich experience of physical activity, independent mobility and other sustainable social and environmental practices.

- Social and cultural sustainability reflecting local identity (D-5) obtained a good performance value equal to 2.20, demonstrating that the variable 'cultural sustainability reflecting local identity' in the surroundings of the school is strongly present, given that the area studied is located in a site rich in historical and cultural elements. This help to forge

children's sense of identity by strengthening their connection to the school and its surroundings. Where they can feel proud of their space if the safety conditions are appropriate. Due to the lack of safety in terms of urban furniture, the 'social and cultural sustainability' variable was not able to promote active and autonomous movement among schoolchildren because of the unsafe road and others deficiencies which lead to accompaniment practices. Therefore, it impedes child's social development and his autonomous mobility.

The total score for the attribute 'Intelligent and sustainable urban furniture' and its variables is -0.24, which means a mediocre performance highlighting that the existing urban furniture elements are not adapted either to the standards of environmental sustainability or to the intelligence achieved by technological advances. Therefore, the school's surroundings are not in line with children's current needs. As a result, children's behaviors are not adapted to the goals and challenges of sustainability because the current situation around schools does not allow for enrichment in terms of mobility practices (Table N°06, Figure N°08).

E- Urban furniture promoting health and social well-being:

Table N°07 and Figure N°08 summarizes the results for urban furniture promoting children's health and social well-being. The acquired scores of the variables and the attribute are as follows:

Table N°07: Pair-wise comparison matrix of performance values of 'Urban furniture promoting health and social well-being' attribute and its variables

Variable	E-1	E-2	E-3	E-4	E-5	Performance value	Standardized value
E-1	1.00	0.83	0.22	0.15	0.12	0.04	- 1.04
E-2	1.33	1.00	0.31	0.18	0.13	0.06	- 0.91
E-3	4.67	4.00	1.00	0.50	0.25	0.16	- 0.30
E-4	6.67	6.00	2.00	1.00	0.50	0.28	0.43
E-5	8.86	8.00	3.33	2.00	1.00	0.46	1.52
Sum of values						1	-0.3
Mean value						0.2	-0.06
$\lambda_{max} = 5.15$			IC= 0.04 %		RC= 4 % (acceptable)		

- 'Children's participation' (E-1) variable obtained mediocre values equal to -1.04 revealing that schoolchildren do not participate in the process of planning or producing street furniture in the school surroundings. This confirms that local elected representatives marginalized and marginalize this vulnerable stakeholder in shaping street furniture that can contribute to promote an appropriate space. The exclusion of children from the process of designing and installing street furniture has contributed to the creation of a space that is unsuited to their specific needs. For example, the absence of road signs and educational panels, the presence of inappropriate bus stops or pedestrian facilities are all elements that limit mobility in the vicinity of the chosen school. As a result, schoolchildren are required

to be accompanied by an adult or their parents, using private cars. In this case, the out-of-school furniture has weakened their link with the school surroundings. To enhance performance, schoolchildren need to be involved in the process of implementing street furniture. This can increase their sense of belonging, encourage them to become more involved in the community and promote active mobility with their peers, as well as encouraging them to adopt more responsible autonomous behavior when moving around schools.

- 'Promoting awareness of sustainable furniture production and use' variable (E-2) obtained mediocre values equal to -0.91 revealing that they do not benefit from awareness-raising campaigns on the production and sustainable use of urban furniture. This confirms that local elected representatives marginalize this vulnerable stakeholder throughout the process of producing and using the furniture. Children who are unaware of the production and use of street furniture tend to be irresponsible in terms of their safety on the streets and around the school in general. This can be seen in the way schoolchildren behave when they are walking around. In addition, the unsuitability of the space due to the many shortcomings in terms of street furniture, as well as the absence of the child as the main designer of his or her space, have resulted in the creation of an unfavorable space for this small user who is often exposed to the road risks. This situation has raised parents' anxieties and led to irresponsible behavior, such as driving children to and from school. The area surrounding the school has become a center of intense traffic. Therefore, their space is not yet suited to proper learning, which has a negative impact on their mobility choices around school. To boost performance, the child need to be aware and informed about his urban rights, to be ready to promote for a sustainable design of city adapted to their needs.
- 'Socio-physical development' variable (E-3) has a poor performance value of -0.30, which shows that the urban furniture around schools does not ensure adequate socio-physical development for schoolchildren, given that the majority of furniture that guarantees good socio-physical learning (Playing, safe movement, sport, etc.) is completely absent. As a result, the existing facilities do not allow pupils for a rich experience in term of mobility practices, to play and to develop their motor skills. Schoolchildren don't spend much time around their school, which is considered to be a place of transit. To promote active mobility, it is crucial to improve interaction through furniture that stimulates social interactivity by creating a learning environment (educational panels, interactive installations or play structures), by promoting emotional well-being (green spaces, relaxation areas, shaded benches), while remaining in line with the notion of Child Friendly design. In short, well-designed urban furniture around schools can be a key element in promoting positive socio-physical development in children.
- 'Social equality' variable (E-4) obtained a good performance value of 1.52, indicating that schoolchildren feel that there is child/child equality in terms of furniture design. This result shows that the majority of children and their parents are not aware of their sustainable civil rights, which emphasize equality between normal children and disabled children (absence of ramps and parking areas for disabled children) and children/adults (the absence of safe furniture arrangements, etc.) in order to comply with child-friendly design standards. The daily accompaniment of the majority of children to school is a strong argument indicating

that this small player is totally marginalized by the existing arrangements made by and for adults. The absence of ramps, the fact that most pavements are quite narrow and other similar features restrict children's mobility and accessibility. Furthermore, the absence of participatory approaches has led to non-inclusive street furniture that does not take into account the diversity of children's needs and preferences (disabled and normal). To ensure better performance and reduce inequalities, there needs to be equal access to quality street furniture around the school (facilities such as playgrounds, sports fields or quality green spaces). This can indirectly reduce socio-economic inequalities by promoting social cohesion and enabling children to move, meet, interact and play together. It fosters a more cohesive school community, reducing potential social barriers. In short, equitable street furniture around schools promotes more inclusive and active mobility for all children, regardless of their social or physical differences. It creates an environment where every child feels welcomed, included and supported in their physical, social and emotional development.

- 'Cognitive and relational development' variable (E-5) has an average performance of 0.43, reflecting the fact that the existing urban furniture does not sufficiently guarantee good development. The school surroundings are considered to be a passage zone for children, the majority of whom are accompanied by an adult on their way to and from school because of the lack of road safety due to the shortcomings of the security arrangements that can be achieved by this micro-element of urban furniture. In order to maintain and improve the existing state, a careful process in terms of street furniture around schools can provide opportunities for children's cognitive and relational development. Through stimulating their curiosity, nurturing social interaction, promoting creativity and providing opportunities for informal learning. This micro-element can positively influence their development and mobility by fostering active behavior, independent exploration.

The total score for the attribute 'urban furniture promoting children's health and social well-being' was -0.06, which is a poor performance value, indicating the fact that the existing state of the urban furniture does not allow for healthy development and an adequate quality of life in the school surroundings. This leads to disturbances in the child's behavior and movements around the school and in urban space generally, especially if the young pupil is always accompanied by another person. In order to improve the health and social well-being of children around the school by means of urban furniture, awareness-raising campaigns for children, to inform them of their civic rights at different levels, i.e. their right to participate and the different facets of equality in terms of outdoor design. By analogy, urban furniture designed according to sustainable child-friendly design standards and in which the child is made aware as an inseparable participant. This process will undoubtedly result in an inclusive urban atmosphere adapted to children's active mobility and autonomous movement through street furniture. Consequently, these physical activities will enable socio-physical development and appropriate well-being for schoolchildren in the immediate surroundings of schools (Table N°07, Figure N°08).

Generally, a total of 16 /24 variables obtained negative standardized values indicating that the majority of urban furniture objectives are not suitable for school children in the surroundings of the school. The total performance value is - 0.19 highlighting the mediocre conditions of urban furniture around schools, which negatively affects children's mobility. This can be illustrated by the irregular and dangerous behaviors of pupils in the area around the school (crossing the road without paying attention, running on the pavement or ignoring the highway code), as well as other accompanying practices on the part of parents or other adults which have contributed to worsening the problems.

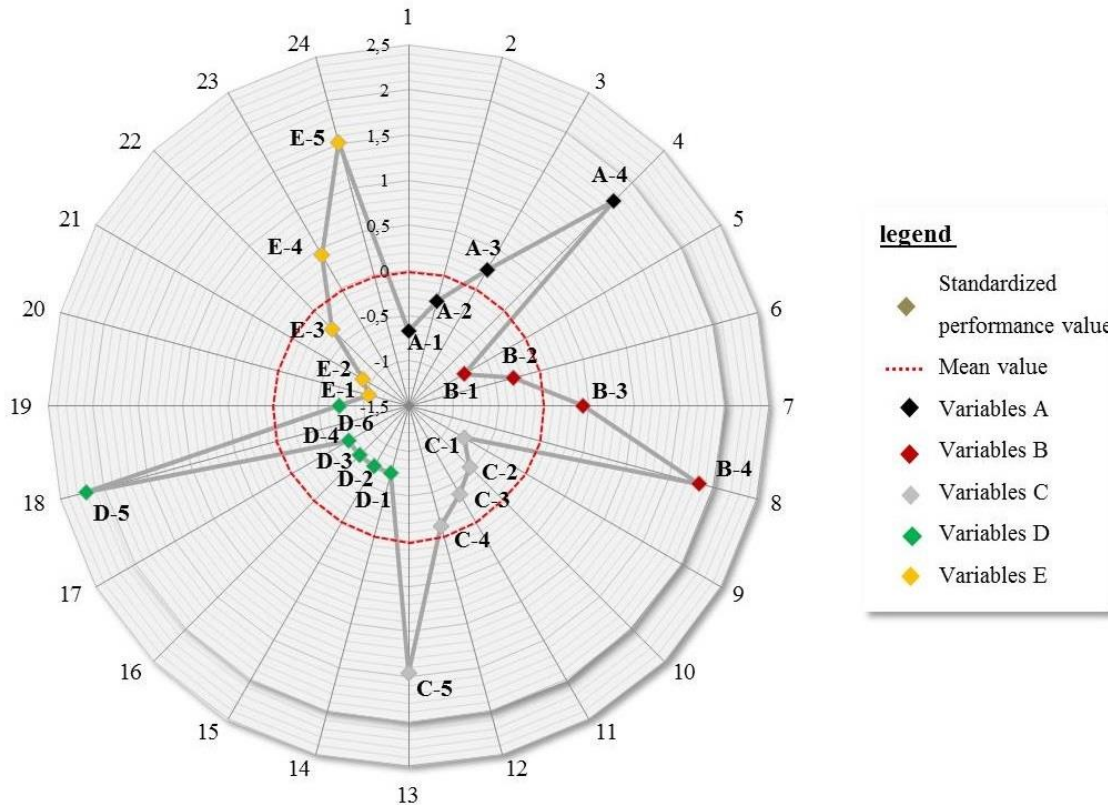


Figure N° 08: Standardized performance values for urban furniture variables around the school. (Source: Authors, 2023)

The results obtained using the multi-attribute approach by means of the AHP process correspond to the findings of the inventory carried out on the school's surroundings, which identified shortcomings in the design of this area, in particular the lack of furniture for the school zone, as well as the recommendations the city of Guelma's new traffic plan, which deemed the situation of these areas to be dangerous, particularly those located at a junction, as in our case (CECOM-CIRTA & DTW Guelma, 2015). The conditions experienced daily by small users restrict their mobility and make their movements unstable and inappropriate. As a result, they are often exposed to danger, particularly when entering and leaving school. Furthermore, the majority of families are always worried as they accompany their children to school. This phenomenon aggravates the situation around the establishment. It also limits their exploratory interaction and restricts their autonomy.

To remedy these problems and improve mobility through street furniture, careful planning is

recommended, based on the sustainable standards for children's planning and the design guides for school zones, which focus on several concepts: children's participation in shaping street furniture that ensures their safety, accessibility, suitability for their size and daily practices in a stimulating, distinctive and harmonized space, while adapting to children's current needs, which include sustainability and new technologies. Appropriate urban furniture can contribute to positive interactions and autonomous mobility by guiding children's pedestrian flows as well as motorized flows. As a result, children grow cognitively and relationally in a healthy way.

The scientific research carried out in the same context of street furniture around schools remains limited. Urban furniture, as a micro-element in urban space, has mainly been considered from a theoretical point of view, or in order to assess its ecological, environmental, ergonomic or social suitability, with the aim of making urban furniture interactive and comfortable for children. Our research has attempted to address the issue of urban furniture in a comprehensive way, touching on several aspects of this micro-element through the notion of 'Child Friendly Design' around schools, as well as guidelines for the design of school zones. The multi-attribute analysis approach based on the AHP process enabled us to carry out an ex-post evaluation by assessing the suitability and impact of the furniture on children's daily lives and mobility around schools. It can be used by local decision-makers to help them make accurate, functional decisions.

During the in-situ investigation, operational constraints were raised, namely: the difficulty of collecting responses from certain pupils because they were not used to being involved in such activities at school. They were not aware of their urban and social rights. At the time of data collection, a lack of data on the manufacturing process and the installation of street furniture are constraints to concrete evaluation. It is therefore necessary to develop local databases to enable researchers to achieve their scientific objectives.

Our methodological contribution can be even more beneficial if it can be modelled in the form of an informatics tool, where children and their parents, educational players and decisions makers can consult each other transparently. Furthermore, given the flexible nature of our multi-attribute analysis, it can be contextualized and used in other public space contexts. In the long term, a sustainable development guide for school zones at local level and according to child-friendly standards should be established.

5- Conclusion

Reconciling children and their urban environment is a major challenge that requires a great deal of effort from scientific researchers. In this context, the present study aims to assess the suitability of this micro-element for children's use and its impact on their mobility and movement behavior around an urban school in Guelma, by verifying whether this micro-element meets the needs of schoolchildren, taking into account the recommendations of 'Child-Friendly Design'.

For this purpose, a methodological process based on a multi-attribute tree has been developed on the basis of theoretical documents (UNICEF documents, guides on school environments, the Convention on the Rights of the Child, scientific research, etc.). It was then used to collect quantitative and qualitative data through on-site observation and a school survey by

questionnaire. The surroundings of the 'Tarek Ibn Ziad' school were selected for the study with a target group of 137 pupils aged between 6 and 12 years.

By applying the AHP process, a total of 16 /24 variables obtained negatives performances values indicating that the majority of urban furniture objectives are not suitable for school children in the surroundings of the school. The total performance value is - 0.19 highlighting the mediocre conditions in terms of these microelements in this area, which negatively affects children's mobility. The street furniture does not meet the current needs of schoolchildren.

The results obtained correspond to the findings of the inventory carried out on the school's surroundings, which identified shortcomings in the design of this area, in particular the lack of furniture for the school zone, as well as the recommendations the new traffic plan of Guelma city, which deemed the situation of these areas to be dangerous, particularly those located at a junction, as in our case (CECOM-CIRTA & DTW Guelma, 2015). The conditions experienced daily by small users restrict their mobility and make their movements unstable and inappropriate. To remedy these problems and improve mobility through street furniture, careful planning is recommended, based on the sustainable standards for children's planning and the design guides for school zones, which focus on several concepts: children's participation in shaping street furniture that ensures their safety, accessibility, suitability for their size and daily practices in a stimulating, distinctive and harmonized space, while adapting to children's current needs, which include sustainability and new technologies.

The flexible process of multi-attribute analysis based on AHP process was used as a decision-making tool to develop an overall diagnosis by evaluating the street furniture around the school and its suitability in relation to the child, his behavior and mobility. It can be contextualized and used in other public space contexts. In the long term, a sustainable development guide for school zones at local level and according to child-friendly standards should be established.

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