# ASSESSING USER PERCEPTION VERSUS ENGINEERING ASSESSMENT: A SAFE ROUTE TO SCHOOL IN KHAYELITSHA

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## ABSTRACT

In South Africa, over 10 million scholars walk to school every day. More than 8 million of these scholars walk a manageable distance to school. However, around 1 million scholars walk, as using a different mode (for example public transport), is too expensive, while almost 480,000 scholars have no other transport available, so walking is the only option. The Road Traffic Management Corporation (RTMC) State of Road Safety Report for 2019 reports that 21% of all pedestrian fatalities in South Africa involved children and young adults aged 19 years or younger. In this study, the authors examined the school routes at Chuma Primary School in Khayelitsha and unveiled that 93.5% of students travel to school by walking. To improve the data input for the computer application, Route2School (R2S) (an application used to assess the routes feeding a school), scholars, parents, and teachers were invited to share their perceptions regarding road safety when travelling to school. Surprisingly, the results indicated that scholars are often found to violate road safety rules, despite rating the infrastructure as safe. In this paper, the perception analysis data is compared with an infrastructure audit conducted using the International Road Assessment Programme (iRAP) toolkit, and specifically the star rating produced for school routes. This aims to address the discrepancy between the real safety conditions and the perceived safety by scholars. This will assist policymakers in formulating safety plans and interventions that consider the specific needs of school zones.

## 1. BACKGROUND

Young people bear a disproportionate burden of road crashes, emerging as the primary cause of mortality for individuals aged 5-29 years old worldwide. The heightened vulnerability of children, coupled with unsafe road conditions in proximity to schools and the increased risk tolerance of young drivers, expose the youth to daily hazards of road-related injuries and fatalities (Li et al., 2016). The grim projection suggests that approximately 500 children worldwide will lose their lives on the roads daily, while over 10,000 will endure life-altering injuries, imparting significant economic and social ramifications for the generations to come (World Health Organization, 2015).

South Africa witnesses over 10 million scholars embarking on their daily journey to school, with more than 8 million choosing to walk, due to manageable distances. However, a concerning aspect emerges, as approximately 1 million scholars opt for walking, due to the prohibitive cost of alternative modes of transportation, and nearly 480,000 have no choice but to walk, due to the absence of available alternatives (STATSSA, 2020). Alarming statistics from the Road Traffic Management Corporation (RTMC) for 2019 reveal that 21% of pedestrian fatalities in the country involve children and young adults aged 19 years or

younger. According to the Constitution of the Republic of South Africa, individuals are entitled to an environment that does not pose harm to their health or well-being. The Constitution mandates the protection of the environment through reasonable legislation and other measures that aim to achieve ecologically sustainable development. Simultaneously, the Constitution emphasises the promotion of justified economic and social development in tandem with environmental protection (The Bill of Rights, 1996, 24).

### 1.1 Aim of Paper

This paper reports on a comparative analysis between the perception data and an infrastructure audit conducted using the International Road Assessment Programme (iRAP) toolkit. Employed by policymakers, planners, engineers, and road safety practitioners, the iRAP toolkit typically aids in developing road safety plans for various transport modes, including for pedestrians at school zones. The findings of this study not only contribute to understanding the dynamics of scholar travel but also offer valuable insights for policymakers and practitioners to implement targeted improvements in school zones, fostering a safer and more secure journey for South African scholars.

#### *1.1.1 Problem Statement*

In South Africa, pedestrian injuries pose a significant threat to the lives of children, particularly those in low-income neighbourhoods. Factors contributing to their heightened vulnerability include insufficient road and walkway infrastructure, reliance on walking as a mode of transport, and inadequate supervision, making it a pressing issue. According to existing literature, younger children walking to or from school alone exhibited riskier road-crossing behaviour than children accompanied by adults or older siblings (Gitelman et al., 2019). The presence of "Negligent Behaviour" when crossing a road significantly correlated with increased pedestrian collision severity. Predictors of such behaviour include a lack of pedestrian safety knowledge and greater exposure to traffic, measured by the time spent walking. In the interaction with the Chuma Primary School community in Cape Town (one of three schools investigated in a broader research project), the authors realised that scholars frequently walk in the road reserve, while pedestrian walkways are available. Furthermore, the scholars expressed this behaviour to be acceptable and infrastructure to be safe. There clearly exists a potential disparity between subjective assessments and objective road engineering. The road engineering situation was, therefore, assessed using the more objective iRAP toolkit. The accuracy of the engineering audit, raised concerns about the accuracy of perception assessments.

## 2. LITERATURE REVIEW

### 2.1 Introduction

Globally, road accidents remain the leading cause of death for individuals aged 5–29 years, as reported by the World Health Organization (WHO, 2015). Within the European Union (EU) member states, there is a general trend of decreasing road traffic fatalities. Official statistics on EU road safety reveal that children under 15 years old account for 4.4% of all pedestrian fatalities (Deluka-Tibljaš et al., 2022). In South Africa, pedestrian accidents are the leading cause of death among children, accounting for around 22% of all pedestrian fatalities for those under 15 years old (Koekemoer et al., 2017). Road traffic incidents pose a significant risk of death and severe injury for South African children, particularly those residing in low-income areas. In the urbanised Western Cape province of South Africa, approximately 35% of pedestrian fatalities in road crashes involve children aged 17 or younger, with those under 10 being the most susceptible (Vanderschuren &

Jobanputra, 2010). Child pedestrian injuries tend to concentrate at specific times of the day, with weekday afternoons being the most frequent period for fatal incidents (Hobday, 2009; Mabunda et al., 2008). That said, a significant number of road crashes involving the youth occur over weekends (Janmohammed, Vanderschuren & Clay, 2018).

In previous studies, various authors explored child-pedestrian behaviour at signalised pedestrian crosswalks and identified key factors influencing their actions. These factors include socio-demographic characteristics (such as age and gender) and how children move (the presence of supervision, and group dynamics), urban infrastructure and traffic conditions (such as crosswalk dimensions and signal timing), as well as risky behaviour, for example distractions due to mobile phone use (Deluka-Tibljaš et al., 2021; Ištoka Otković et al., 2021a; Ištoka Otković et al., 2021b; Otković et al., 2020). Reflecting on this literature, the work in this study underscores the importance of a multifaceted approach that considers both environmental factors and individual behaviours to promote pedestrian safety among children.

### 2.2 Perception of Safety From Scholars

Research on child road traffic safety encompasses various dimensions and attracts attention from diverse fields of study. Literature includes a range of topics:

- Examination of traffic accidents involving children and adolescents in various capacities, such as pedestrian, cyclist, or a passenger in vehicles.
- Investigation into injuries stemming from traffic incidents.
- Scrutiny of children's and adolescents' traffic habits, considering factors like age, gender, socio-demographic traits, and the influence of distractions like mobile phones.
- Evaluation of the role of infrastructure in ensuring the safety of children on the roads.
- Assessment of the effectiveness of traffic education programs in promoting safe behaviour among young people and other demographic groups.

A study conducted by Ampofo-Boateng & Thomson, (1991) explored the street-crossing abilities of children aged 5 to 11 years, finding that 5- and 7-year-olds exhibit poor skills in identifying dangerous road-crossing sites, relying solely on the presence of visible cars. Nine-year-olds show improved abilities, and 11-year-olds demonstrate good judgment, indicating that younger children may be at significant risk due to their inability to recognise dangerous locations. The study shows the potential that can be achieved by road safety education. In addition, it has been noted that children typically feel a sense of safety in their surroundings when beneficial pedestrian measures, such as crosswalks, traffic signals, and wider sidewalks, are put in place (Alonso et al., 2017; Ampofo-Boateng & Thomson, 1991; Li et al., 2016). This paper aims to investigate the assessment of infrastructure and the evaluation of perception behaviour concerning awareness of traffic safety concerns among learners as they walk to and from school.

## 3. METHODOLOGY

### 3.1 Study Design

This research utilised a combination of qualitative and quantitative approaches to assessing how scholars perceive road safety, along with evaluating the actual safety rating of the road facilities they use. Comprehensive data documentation and analysis were conducted using the iRAP and R2S tools. Figure 1 below shows the study design.

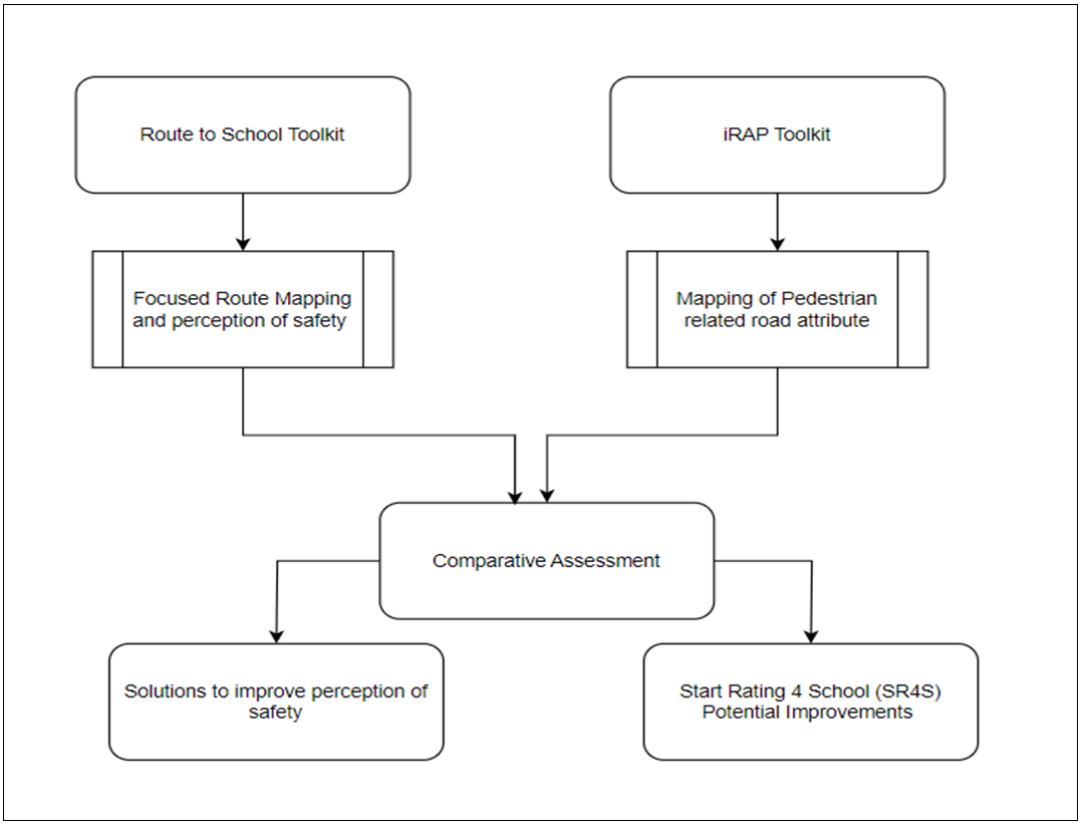


**Figure 1: Study design for the comparative analysis**

## 3.2 iRAP Toolkit

The iRAP toolkit (Rogers, 2017) provides global benchmarks to assess safety performance, software to simplify road evaluations, and support for various projects. The initial component is the starting rating, which is employed to impartially gauge the probability and potential severity of a road accident. This assessment considers all road user types and is based on identifying specific road attributes that significantly impact the most frequent and severe types of crashes. To generate Star Ratings for roads, it is necessary to extensively code road attributes. This involves utilising readily available data and geo-referenced images obtained during the planning of roads or assessments of existing ones. The coding process aims to document a diverse set of measurable characteristics for every 100-meter section of the road. These attributes serve as the basis for determining Star Ratings. For shorter road lengths or specific locations (100m segments), the Star Rating Demonstrator can be employed for coding. The Star Ratings range from five stars, indicating the safest roads, to one star, representing the least safe. In the recent past the tool has expanded the approach to identify specific vulnerabilities for instance of major concern is the school children. The approach relies on categorising attributes according to their risk levels across four tiers of examination. Each tier encompasses specific attributes targeting communities (first level), discerning characteristics of schools and risk elements in the built environment (second level) and evaluating pedestrians' exposure (third level). The ultimate level (fourth level) involves the Star Rating for School assessments, wherein a more thorough road safety evaluation is performed for schools identified as high risk in the preceding levels. In the case of this work road sections that were identified in the R2S mapping were coded using the criteria provided in the iRAP program.

### 3.3 Route2School Tool (R2S)

The R2S Tool is a road safety assessment tool developed by the Transportation Research Institute at the University of Hasselt in partnership with ABEONA Consult (Abeona,2023). The Route2School tool specifically concentrates on evaluating the safety of scholars' journeys to school. This is achieved through a comprehensive examination of the infrastructure related to road safety and the travel habits of students along specific routes. The effectiveness of this approach lies in its ability to pinpoint obstacles, such as poor road conditions, problematic traffic behaviour, inadequate crossing facilities, and the absence of pedestrian walkways. By focusing on the routes commonly taken by children during their journey to school, this tool successfully identifies and addresses potential bottlenecks that may pose safety risks. These bottlenecks encompass various factors, ranging from the quality of the road surface to the patterns of traffic behaviour, as well as the availability or lack of secure crossing points and pedestrian walkways. The tool's success lies in its capacity to conduct a thorough analysis, offering insights that contribute to enhancing the safety of children commuting to and from school.

### 3.4 Study Area

Khayelitsha, situated east of Cape Town's city centre, is home to a population of 391,749 people. The majority (99%) are Black Africans, and 28% of the residents are under 15 years old. The area comprises 118,809 households, with over half (55%) residing in informal dwellings (STATSSA, 2020). The study took place at Chuma Primary School in Khayelitsha on Govan Mbeki Road, situated in a low-income community in or on the outskirts of Cape Town. This location was selected based on qualitative data obtained from the Route to School Trans-safe project and the observation of a significant number of crashes on this road.

### 3.5 Data Requirements

This study considers data requirements encompassing both quantitative and qualitative aspects. Employing the iRAP methodology, information about the study section includes variables like vehicle speed and volume, the presence and condition of sidewalks, crosswalks and lighting, lane count, median design, driveways, intersection style, and the presence of traffic calming measures. Additional features included school zone signage and markings, school zone crosswalks, and school zone law enforcement. Within the R2S approach, participants are prompted to input their home, destination, and route details. The application then automatically generates a route based on the specified origin and destination points to align with the participant's actual trip. Additionally, participants are requested to identify areas where they perceive safety concerns (referred to as perceived bottlenecks). They are required to provide a description of the issue and propose a solution. To pinpoint these unsafe locations accurately, participants must upload images using the R2S tool, utilising either the downloaded smartphone application or the web application on a computer.

## 4. RESULTS

### 4.1 Route to School (R2S)

Based on R2S app data, 107 respondents from Chuma Public Primary School took part in the R2S Project. Of these, 86% were scholars, and the remaining 14% included the

principal and school teachers. Regarding mode use during bottleneck reporting, 90.9% of scholars walked, 4.5% used cars, 1.5% rode their bicycles, and 3% used other unspecified modes (private school transport, e-hailing, etc.). The R2S application received reports from scholars, parents, and teachers, totalling 107 trips/routes and identifying 66 bottlenecks. Among the reported bottlenecks, the primary concerns included traffic behaviour (27.8%), vehicles exceeding speed limits (28.8%), dangerous intersections (13.6%), absence of pedestrian and bicycle paths (13.6%), and poor road surfaces (16.7%). The R2S tool's automatic analysis revealed that 27% of reported issues were located within 200 meters of Chuma Public Primary School, while the remaining 73% were beyond this boundary. Figure 2 shows a visualisation of all the routes documented during the data Chuma primary school data collection.

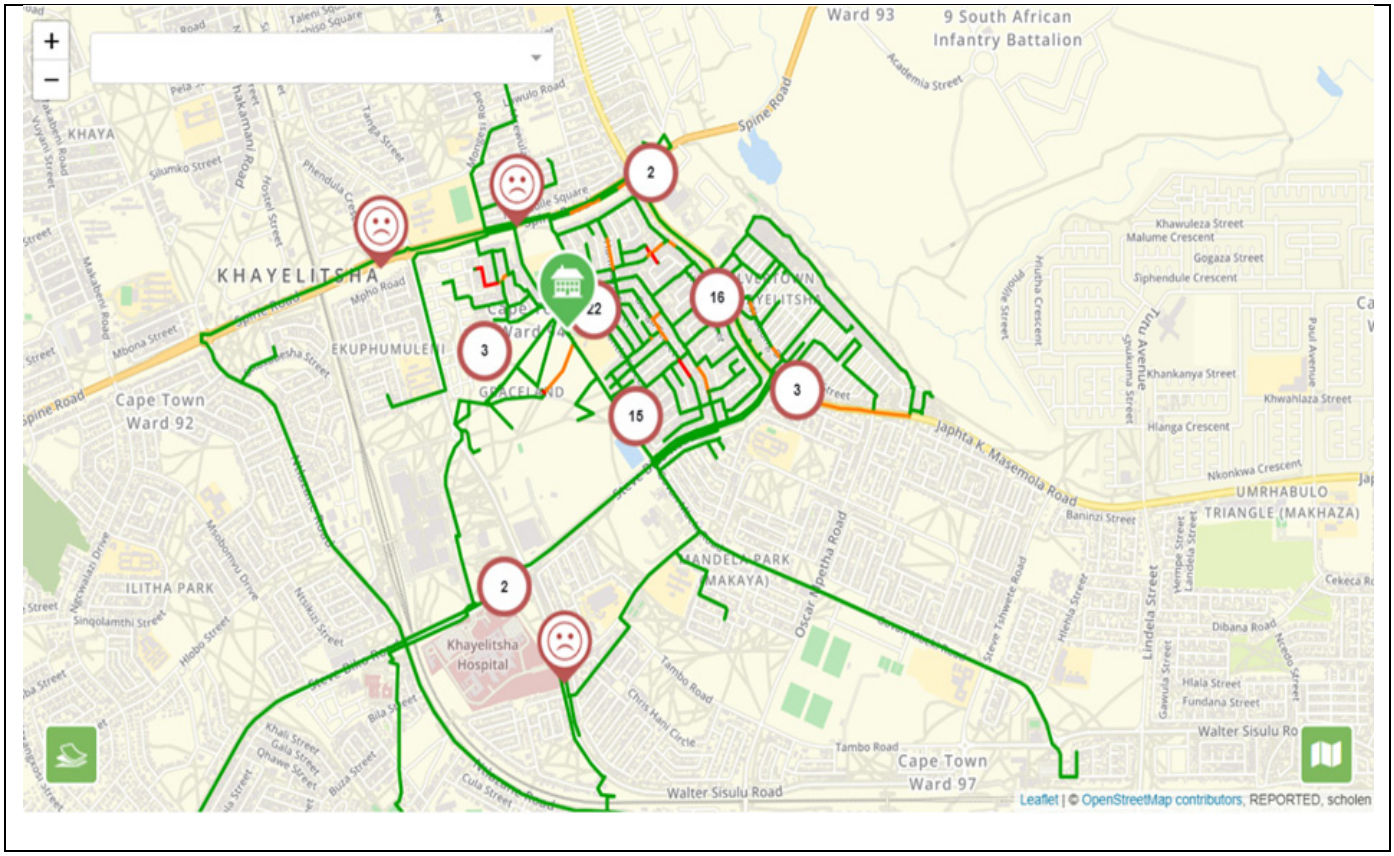


**Figure 2: Route to School Chuma Routes visualisation**

The R2S assessment revealed a discrepancy between perceived safety and the actual safety rating of the roads surrounding the school. It was observed by the research team that scholars at Chuma Public Primary School often mentioned walking along the road reserve, citing the lack of pedestrian facilities as the reason. Curiously, they did not view this as a risky activity. This indicates a possible discrepancy in reporting genuine obstacles and underscores the need for specialised infrastructure assessments to complement the R2S dataset. Furthermore, it emphasises the importance of imparting road safety education to students.

## 4.2 iRAP Assessment

The star rating analysis was conducted for two specific locations delineated on the map provided. Notably, both sites are situated near schools. The assessment spanned 865 meters, extending from the Spine Road junction to Steve Biko Road. These locations were strategically chosen due to the bottleneck areas identified during the R2S exercises for Chuma Primary School. Figure 3 depicts the two locations chosen for the iRAP analysis. Upon examination, the analysis of these locations revealed a notably low rating according to the school star rating system.


**Figure 3: iRAP assessment sections/locations**

One location is situated immediately after Spine Road near Thembelihle Secondary School, while the other is located right outside Chuma Primary School. The R2S analysis indicates that most bottlenecks occur as students from Chuma Primary School move farther away from the school. The star rating at this location is 1.4 out of 5, as shown in Figure 4. At the top is a satellite image showing the section of the road that has been star-rated, while below the actual parameters utilised for the School Star Rating Demonstrator is shown. Despite low operating speeds in this section, there is an evident requirement for infrastructure enhancements to better serve the students.

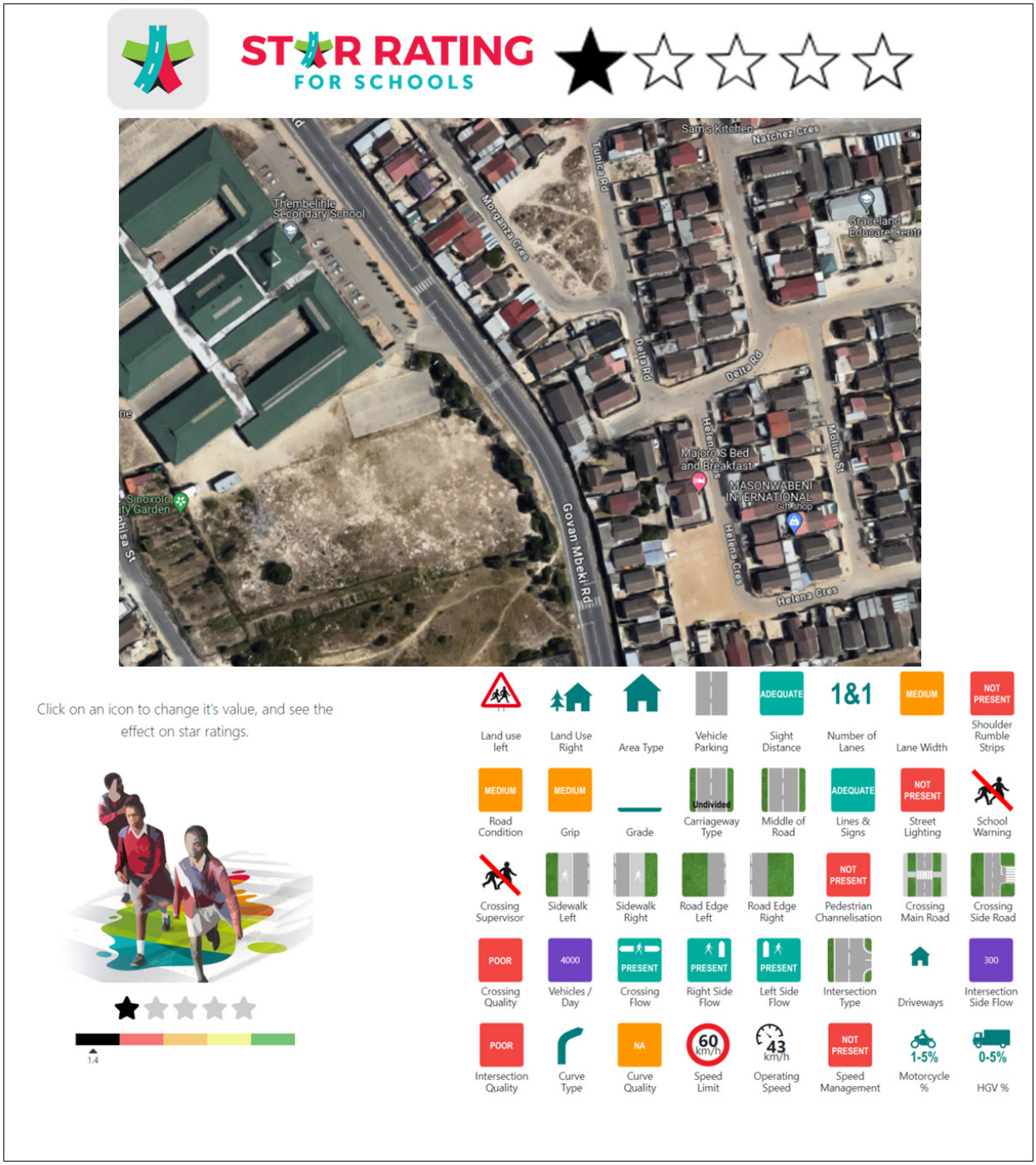


**Figure 4: Thembelihle Secondary School Start Rating**

This investigation has uncovered a discrepancy between the perceived safety and the actual safety rating of the section as reported by the scholars. Despite the scholars' perception that walking along the road edge lacks danger, the objective safety assessment suggests otherwise. This incongruity underscores the importance of looking deeper into the reasons behind such perceptions and addressing any underlying issues. Further exploration into the discrepancy may reveal insights crucial for enhancing road safety measures in the area.


**Figure 5: Chuma Primary School Start Rating**

## 5. DISCUSSION

The findings of this study shed light on the significant challenges faced by scholars in South Africa as they journey to school, particularly the large number of child pedestrians who face unacceptable road safety challenges. Previous literature reveals a concerning trend wherein a substantial portion of scholars walk to school due to financial constraints or lack of alternative transportation options, exposing them to heightened road safety risks. Furthermore, the high incidence of pedestrian fatalities involving children and young adults underscores the urgency of addressing road safety concerns in school zones.

The examination of the routes to Chuma Primary School underscores the critical need for a comprehensive approach to improving pedestrian infrastructure and promoting safe travel practices among scholars. Despite scholars' perceptions of road safety, the

infrastructure audit using the iRAP toolkit reveals discrepancies, indicating areas for targeted intervention and improvement. By bridging the gap between perception and reality through data-driven analysis, policymakers can better prioritise resources and develop tailored safety plans that address the specific needs of school communities. A SWOT Analysis was used to describe the outcomes of the investigation and some of the interventions that are identified from both approaches. Figure 6 shows the outcomes of the investigation.

## 5.1 Strengths

The study addresses an important issue concerning the safety of routes to school in Khayelitsha, contributing to the literature on urban safety and transportation. Some of the identified safety features from the iRAP is for a good demarcation of school zone through signage, school zone markings on the road and pedestrian channelisation.

## 5.2 Weaknesses

The study mainly suffers from biasness of perception of safety, especially where the perception of safety is evaluated form the surveys within the school environment. What was evident from the study is that the perception of safety was skewed based of observations and the finding from the iRAP assessment. User perceptions of safety, influenced by individual experiences and subjective factors, which may not accurately reflect the objective safety of the route as assessed on the star rating which where all on the black section.

## 5.3 Opportunities

Findings from star rating present opportunities for policymakers to implement targeted interventions such as school zone signage, and speed reduction measures to improve the safety of routes to school in Khayelitsha based on user perceptions and star ratings. The study opens opportunities for integrating technology, like mobile applications or crowd-sourced data collection platforms such as the R2S framework.

## 5.4 Threats

Socio-economic disparities and structural inequalities in Khayelitsha could hinder efforts to improve route safety, requiring a comprehensive approach that address underlying social and economic factors. There is a need to create awareness on the road safety issues in the low-income communities. Although there are resource constraints the effort to bring down fatalities requires low-cost interventions.

The study pinpointed several key solutions, such as enhancing infrastructure, promoting education and awareness, advocacy efforts, fostering community engagement by involving parents, teachers, and scholars, and prioritising data-informed decision-making. This holistic approach, informed by both perception data and objective assessments, is essential for creating safer environments for scholars as they travel to and from school, ultimately contributing to the reduction of pedestrian fatalities and the promotion of safe mobility for all.

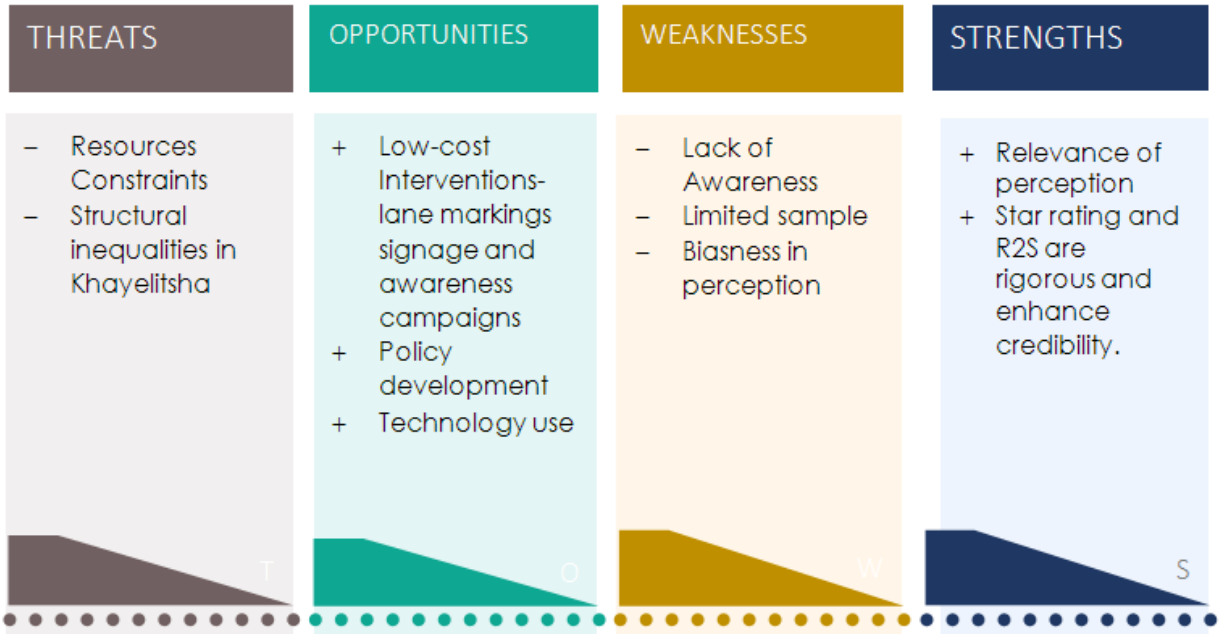


**Figure 6: SWOT Analysis used to describe the outcomes of the investigation**

## 6. ACKNOWLEDGEMENTS

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