WALKABILITY ASSESSMENT FOR SCHOOL-GOING CHILDREN

CASE STUDY: OTJIWARONGO TOWN - NAMIBIA

Thesis submitted in partial fulfillment of the requirements for the M.Phil. In transport studies, centre of transport studies at the University of Cape Town

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Date: 30 November 2018

Declaration

I hereby declare that this master's thesis is the result of an independent investigation and that it has not been submitted to the University of Cape Town or any other university in any version for the purpose of examination. Where citation was made from work written by other scholars, or researchers, acknowledgement has been duly made.

Signature: Signed by candidate

Date: 30 November 2018

Acknowledgement

First and foremost, I would like to express my gratitude to God, for guidance and strength to carry out this study. I am also sincerely grateful to my supervisor Associate Professor Marianne Vanderschuren for her direction, intellectual inspiration and guidance throughout this work. Despite her busy schedule, she always allocated time to provide direction and useful feedback.

I also express my genuine gratitude to the scholars that provided me with the data for this study, not forgetting the parents and school principals who gave me permission to engage with these scholars.

Abstract

This study focuses on assessing the walkability of scholars in the Otjiwarongo Town municipal area in Namibia. The research looks at the overall infrastructure and the conflict between pedestrians and motorists. This study is done to find out the serviceability of walkable paths and their existence for school-going children, how safe they are, and the state of their quality, shelters and visibility. It also reveals the level of conflict scholars tend to encounter on their respective routes every day, and identifies improvements that can be made in order to make it easier for them to walk.

Through a literature review from different fields and through an empirical study, this project investigated the concept of walkability by trying to understand the different ways in which the built environment influences walking, e.g. directly influencing the quantity of walking through linking destinations, or enhancing the experience and the quality of walking by determining the condition of roads and sidewalks as a walking environment. It also investigated the different aspects of walking by partitioning walking activities and understanding how they are influenced by different properties of the built environment. By partitioning both the influence of the built environment on walking and the walking activity, the knowledge that this thesis tries to produce is not only on whether or not, but more on how and why the built environment influences walking behaviour.

Scholars were used as participants and they were briefed on what was expected of them and the questionnaires were explained to them. The participants came from two different schools and they were randomly selected. Data was analysed using the average or the highest number of respondents from the areas of study on specific criteria. The results of this study are mixed, meaning some areas are worse for walking, while others are much better. The poor area has worse minor streets linking to the main road which is better for walking, and this is in the old suburbs. Newly developed suburbs show good, walkable streets. This is because they were designed according to modern changes in residential area development or beautifications. Orwetoveni suburb has a better walkable rating than Central Town. The municipality needs to improve the walkability of streets

rather than paying too much attention to motorists. Pedestrians and cyclists also pay rates too, just as motorists do.

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1: Introduction

1.1 A description of what motivated the research

Otjiwarongo is a town located in the central part of Namibia about 245 kilometres north of the capital city of Windhoek. The town hosts four secondary schools and seven primary/combined schools. Some are schools that have both primary and secondary classes. Walking is the common means of transport for the inhabitants of the town, especially for school-going children who daily cover long distances by walking.

It's against this background that an assessment on the walkability for scholars in Otjiwarongo town was conducted by looking at the security, safety, comfort and attractiveness of their walking path, both to and from school. Walking is the preferred mode of transport as it is cheaper and provides children with an opportunity for increasing physical activity.

The problem that is addressed in this research is the presence or not of walking path facilities and the how good they are in terms of universal access standards. The study attempts to evaluate the present situation and how it could be improved in future, to make walking safe for scholars.

1.2 Aims of the research

Investment in walking and cycling facilities creates a new society, where people of all incomes can meet as equals on a bike path or sidewalk. Appropriate infrastructure tends to reduce conflict/incidents between pedestrians and motorists, as the paths are demarcated or separated from one another. Having proper infrastructure helps to reduce traffic fatalities. According to the World Health Organization (2004), the leading cause of death among young people in developing countries is traffic accidents because of poor infrastructure, where non-motorised modes of transport compete for space with motorised vehicles.

Conflicts between motorised and non-motorised road users are most common in developing countries (including Namibia), due to a lack of interconnected secondary and tertiary street networks, which would allow slow-moving vehicles to bypass major arterials.

Pedestrians are forced to walk in the road because sidewalks have been so poorly designed that they are virtually inoperable or don't exist at all. Conflict over the use of sidewalks is common

among pedestrians, street vendors and parked vehicles.

Based on the above, the aim of this thesis is to conduct a walkability assessment, to find out the level of serviceability of walkable paths, their existence for school-going children, how safe they are, their quality, shelter and viability. The level of conflict scholars tends to encounter on their respective routes every day is also investigated. Hence, evidence based improvement can be proposed regarding these walk-ways for the safety of users, by submitting the final results to the relevant offices. For example, the municipality of Otjiwarongo could allocate sufficient resources to upgrade streetlights on these walking routes to improve the scholars' or general public's safety and security through proper lighting. This is most important from the April month to September, where the sun rises late and school time remains the same.

Other reasons to conduct this walkability assessment among school-going children in different locations of the town of Otjiwarongo, reasons are:

- Determine quality walking paths available to school-going children,
- Find out the main reasons that encourage the children to walk, and
- Identify improvements that could be made, to make the walk better for them.

1.3 Research Questions

The study will answer the following questions.

1. Why do scholars walk to school?
2. What are the benefits of walking to school?
3. What are the problems (including conflicts with motorised road-users) that scholars face when walking to school?
4. Where are the routes to school?
5. Are there safer routes to school that could be used?

1.4 Research methodology

1.4.1 Introduction

In this section, the method to be used to collect and analyse data is discussed. It also describes the target population, the sampling procedure, the sample type of research instruments that are used and the procedure for data analysis.

1.4.2 Research design

This study used a mixed research method. This is a type of research in which a researcher or team of researchers combine elements of qualitative and quantitative approaches, (for example, the use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the purpose of breadth and depth of understanding and corroboration.

1.4.3 Target Population and Sample: Size and procedure

The target population for this study was school going children of combined and secondary school learners in the town of Otjiwarongo. A total of 13 learners who walk to school participated in the study. They came from different schools in the town and lived in different suburbs. This was done for easier data analysis, which was done through random sampling, which meant that everyone in the entire target population had an equal chance of being selected. Random samples require a way of naming or numbering the target population and then using some type of raffle method to choose those to make up the sample. In this study, scholars from these two residential areas were identified and routes to be used were raffled in a bowl, where they picked the routes to walk for this study. Random samples are the best method of selecting your sample from the population of interest (McLeod, 2014).

Every learner was given a questionnaire, by means of which they indicated what they had observed on their specific route or walking path and their responses were treated as confidential. Scholars went through briefing sessions, to inform them of the exact type of data which was needed for the study and the aims of the study. This helped them to provide useful and precise data.

1.4.4 Research instrument

This mixed method study conducted primary and secondary research. The primary source of data came from the questionnaire developed by the researcher, observation and the use of Maps from Smart Phones to trace scholar walking paths for verification that they did indeed walk. The primary data frequently gave detailed definitions of terms and statistical units used in the study. These are usually broken down into more refined classifications. The secondary sources of data came from published articles, the town maps, which showed the area demarcations and school locations. The researcher initially planned to use police reports on motor vehicle/pedestrian-related accidents on the assumption that the data was easily accessible, but they were not used, due to poor record keeping by the police, due to lack of computerised system in place for easier access.

1.4.5 Data analysis

The quantitative data was analysed using the ranking according to participants' responses. It is a systematic approach to investigations during which numerical data is collected and the researcher transforms what is collected into graphs and tables. Qualitative data was analysed by a reflective analysis. This analysis gives the opportunity to critically examine the participants experience and connect it to what the researcher has learnt. The description and evaluation of the studied phenomena were based on the judgment and intuition of the researcher, with aid of other publications available from other authors. Participants were required to fill in forms with questions and a set of possible answers. While the quantitative focus was on numerical scores, where the participants were asked to rank the current areas, for example, 1-5, one being poor and five excellent, Micro Office Excel was used for data analysis. Presentation was done using graphs and charts. The universal design walkability audit and specifically, walking, were used as a benchmark to be able to see if the town does meet basic requirements for pedestrians, which is highlighted in the coming chapters.

The research is presented in a written form with the addition of data charts, which present the findings. Tables, graphs and network charts were used to illustrate some of the analysed data.

1.5 Ethical issues

There are two ethical issues to be highlighted. Firstly, as the participants were scholars and under the age of 18 years (i.e. minors) it was necessary to obtain the consent of their guardians or parents. The author drew up a letter to be signed by parents or guardians, on behalf of their children. The letter set out what type of information was sought and for what purpose. It stressed that the information supplied and the identity of participants would be treated as confidential.

The second issue concerned the use of the questionnaire. The questionnaire had previously been used. It had been generated from the walkability applications developed by the University of Cape Town. However, the author was the first person to use it in Namibia, specifically Otjwarongo. The author has made some adjustments to the questions to suit the local environment. Associate Professor Marianne Vanderschuren granted permission for the use of the questionnaire and the ethics committee has issued the author with a clearance.

1.6 Scope and limitations

The study focused only on the walkability of scholars in the town of Otjiwarongo, and specifically the centre of town and Orwetoveni residential area. These areas have five schools and scholars from only two schools, namely Otjiwarongo Secondary School and Donatus Secondary School, participated in this research. The data collection was done by scholars who were given a week to complete and return the questionnaires.

The small size of the sample and the small number of participants in the study raised the question of the validity of the findings. The author initially planned to use 30 scholars, but only 13 participated. The main reason was the time-frame, willingness to participant and that the scholars wanted to be paid, which the author could not afford. The secondary data the author initially planned to use was to have been police reports, but due to the unavailability of organised reports from the police, this source of data was later removed from the study.

1.7 Thesis outline

Chapter 1, looks at the general concepts in the introduction. This includes the research area, why it was chosen, definitions, the scope of the study and its limitations. It also sets out the ethical issues that were considered.

In Chapter 2, the related literature review is presented to explain the relevance of this study. More information is given from other researchers and book authors on walkability, evaluations, safe routes, the benefits of walking and how these benefits can be measured. Factors that discouraged scholars from walking were also discussed.

In Chapter 3 research methodology is further discussed, starting from the sample size, target populations, how sampling was done regarding types of data and the data collection instruments used. Data analysis is also discussed, explaining clearly how it was done.

Chapter 4: the description of how the study was conducted and how the data was collected and documented is given. To describe the content of the data collected from observation, a general description of the walking behaviour patterns and the walking conditions in the study areas is given.

Chapter 5: provides the conclusions the author drew from the results and the overall process. This chapter discusses key takeaway points from each chapter and makes recommendations for future studies. The concluding chapter explores the limitations of the data collection instruments.

2 Literature review on walkability

2.1 Introduction

Different researchers have studied the relationship between the built environment and walking behaviour and although recent, the field has been gaining traction in different research fields, for example: transportation, public health and urban planning. (Saelens et al.2003.p80).

The public health field has been actively researching the correlation between environmental variables and physical activity (including walking) and has contributed greatly to the finding that the built environment does affect walking behaviour. This includes the design of residential areas and the impact it has on the community and members' inclination to walk. For example, the design of the environment with a longer road without access roads. Transportation and urban planning studies have also provided evidence that urban features and transportation systems are related to walking activities. Still, the existing evidence raises many questions regarding characteristics that seem to be related to physical activity and we need additional evidence regarding the relationship between micro-level measures of the built and natural environments and physical activity (Daniel et al.2006.p43-54).

2.2 What is walkability

For the purposes of this study, walkability is defined as the extent to which the walking environment provides safe and direct connectivity to destinations while minimising travel time and effort, as well as offering a comfortable and pleasant visual environment (Southworth, 2005, p247-248). There are various other definitions for the term walkability that sometimes evolve, depending on the scope of measurement and estimation variables, such as accessibility, walking rates, residential density, network connectivity and land use mix (Southworth, 2005, p248).

Although an individual's ease in accessing destinations by walking is impacted by both the physical environment and socio-economic environment, "walkability" is a term, generally used to describe the sum of physical design elements which enables the built environment to support and encourage walking, by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time, with little effort and offering visual

interest in journeys throughout the network. A highly walkable environment invites walking by means of a richly connected path network that provides access to everyday places where people want to go. It is safe and comfortable, with streets that are easy to cross for people of varied ages and degrees of mobility (Glanz and Sallis, 200.p90). Spaces are attractive and engaging to be in, with trees or other landscape elements. Routes are also coherent, but in different built form and visual connection with the life of the place. The pedestrian network links seamlessly, without interruptions and hazards, with other transit modes such as bus, tram, or subway, minimizing automobile dependence (Lukenangula 2017.p18). The path system is sufficiently to be explorable over time, offering varied visual experiences with repeated encounters.

However, walkability is considered indifferently in developed and developing countries, according to Cervero and Kockelman (1997), cited by Lukenangula (2017.p64-65). They argue that the concept of "walkability" arose out of research on transportation in the United States of America in the late 1990s, in which the dimensions of the built environment related to 'walking for transport' were considered. These were thought to include: street connectivity; residential density and mixed land use. Street connectivity meant the number of intersections in a given area; while residential density referred to the number of people living close together in a given area and mixed land use, simply meant a mixture of residential, commercial, retail and recreational land uses in such a way that individuals could walk for multiple purposes, such as work or school (Moudon et al., 2003.p 33-38).

Typical examples of walkable cities include New York in the USA, Hong Kong in China and Paris in France. Since its inception in the transportation field, physical activity and public health researchers, practitioners and policymakers, have adopted the concept of walkability. As walkability was adopted on the worldwide stage, features like bicycle lanes, public transit and footpaths become more important. Paulo (2012.p18) has also argued that "walkability" has probably been brought to the debate in connection with road infrastructure improvements by Chris Bradshaw, a city planner and expert, in 1993 following a property tax rise in Ottawa in 1992.

Following such changes, the landlords and local shop owners claimed that most people in their neighbourhoods walked for their daily trips rather than drove (Paulo, 2012.p18).

Land uses, connected street networks and compact building design have been attributed to formations preceding suburbia, often characterised as “traditional” and walkable (Glanz and Sallis,2006). Together, the aforementioned design elements allow for proximity between “homes, stores, employment centres and government services”, which is conducive to walking and biking for transport, ideally within a distance of less than one-half mile (Leslie et al, 2007.p113). An index of pedestrian level design elements commonly utilised in walkability indexes is found in Table 2.1 below.

<table>
<tr>
<td>Sidewalks

• Accessibility
• Sidewalk widths
• Sidewalks and driveways,
• Sidewalks’ surface quality and pavement treatments</td>
<td rowspan="3">Intersections

• Curb radii
• Curb facilities and design
• Curb cut-outs
• Marked crosswalks
• Pedestrian crossing signals and signage
• Curb extensions
• Alternative designs roundabouts
• Raised intersections
• Neighbourhood traffic signals</td>
</tr>
<tr>
<td>Mid-Block Crossings

• Medians/ crossing islands
• Crosswalk design
• Raised crosswalks
• Speed limits
• Lighting
• Street lane width</td>
</tr>
<tr>
<td>Traffic Calming

• Two-Way to One-Way Conversion
• Speed Humps Source</td>
</tr>
</table>

Table 2-1 Pedestrian safety Indicators

Source: *Shelling, 2010*

2.3 The importance of Walking

Walking is a fundamental way for people to move, or get from A to B and to assimilate the urban landscape. It is the most natural way for the human being to travel, enabling the human body to exercise both physically and mentally (Paulo, 2012.p.4-6).

Furthermore, walking is the foundation of the sustainable city, presenting a number of social, environmental and economic benefits when compared to other means of transportation. In regard to the environment, because it is an alternative to car usage, it reduces air pollution,

traffic congestion, oil dependency, hence, decreasing the emission of greenhouse gases and, at a global level, slowing down climate change (Park, 2008.p7).

From an economic point of view, the act of walking may benefit businesses such as high street retail, restaurants, and tourism-related activities (Paulo, 2012.p5). Walking as a mode of transport is free of charge and accessible to all social classes. Walking has been described as a vital way to promote social and spatial interactions, therefore making public space and the urban setting as a whole a more pleasant place to live, and creating liveable communities. Walkability has also been associated with economic benefits. Walking benefits, the local economy by increasing foot-traffic. This allows access to markets and makes it easier for businesses to advertise more effectively and attract customers, while promoting sociability.

The walkability of an environment has been demonstrated to contribute to sustainable communities and healthy living habits, by providing a good walking path. It also helps reduce negative elements in the society, like a reduction in air pollution and traffic congestion (Kenworthy, 1999.p165-167). A walkable environment around schools or towns may help to further promote walking as the dominant mode of transportation, therefore, supporting a healthy lifestyle for school-going children and society at large (Paulo, 2012).

Victoria Walks Organisation (Garrard,2017, p53-59) further indicates that walking to school is good for the child's physical health. He argues that, children who walk or cycle to school are able to concentrate much better than others, for the first four hours of the day. Walking to school is not only good for a child's health and education, but it also helps them to understand their environment as it allows them to describe the area they live in. The capacity to walk in their neighbourhood is highly important to children's independent mobility and their general development.

The goal of walking varies from community to community. Some rally for safer and improved streets, some to promote better health habits, and finally, for some it is the only mode of transport or movement available.

Active and Safe Routes to School (National Highway Traffic Safety Administration, 2017) indicated the disadvantages of children walking, arguing that; children who do walk to school more than their peers tend to be exposed more frequently to poor air quality and speeding

vehicle. Based on these factors, which parents deem dangerous, parents are forced to drive their kids to school. Active and Safe Routes to School (National Highway Traffic Safety Administration, 2017) looked at the benefits of allowing children to walk to school. The first benefit is that it allows scholars to be active, leading to their being more alert and active in class. Walking also helps with improving their self-esteem and it gives them independence. It further indicates that physical activity prevents obesity and promotes a healthy living style.

2.4 Evaluating Walkability

According to Jaskiewicz, (2000.pg-1/1) the pedestrian Level of Services (LOS), depends on many factors that affect the walkability of an environment, including the complexity of path networks, the presence of buffers between pathways and roadways and the presence of shade.

However, Namibia has some historical issues, as most of the Otjiwarongo town's development happened before independence and were not designed in a way which would provide for pedestrians with the necessary infrastructure, as it was based on the racial segregation of facilities. The better schools were located in the Central Town area. This have made most of the scholars to prefer schools in the Central Town.

Park (2008.p2) indicated that sidewalk amenities, traffic impacts, street scale and landscaping significantly influenced the perceived walkability of any environment. Other criteria, such as quality of sidewalks, street design, and land use patterns, linkage to another mode of transportation and safety aspects have also been taken into consideration to contribute to the walkability of an environment (Southworth, 2005.p247-249).

Furthermore, Southworth (2005.p250-257) continued by arguing that, quantifying walkability is a difficult task because the walkability of an environment is dependent on multiple factors. The most commonly used indicators of walkability are ease of street crossing, sidewalk continuity, local street characteristics and topography.

There are four major indicators of perceived walkability (accessibility, pleaser ability, perceived safety from traffic and crime). However, these indicators are different from the one mentioned previously. Southworth (2005.p249) identified similar criteria for walkable cities, including connectivity of path networks, linkage with other modes of transportation, land use patterns, safety from both traffic and crime, and quality of path. The quality of the walking path

is the key, as it tends to have either a negative or positive effect on walking, and can be rectified through proper design. A good walkable network must possess the following important attributes:

- Linkage with other modes of transport, e.g. bus, taxi and train,
- Safety, both from traffic and crime, and
- The quality of the path, including width, paving, landscaping, signage and lighting, and path context, including street design, visual interest of the built environment, transparency, spatial definition, and landscape.

2.5 Walkability Measurement

Walkability measurement is primarily concerned with quantifying the physical aspects of the built environment that may impact walking behaviour (Saelens et al., 2003p84). Walkability measurement can also consider indirect built environment attributes, such as perception, meaning the attractiveness and suitability of the built environment for outdoor activities, which may have beneficial or detrimental impacts on walking (Brown et al., 2008 p1301). Measurement of built environment factors may include walking facilities, such as the presence and quality of sidewalks and crosswalks, the number of vehicle travel lanes, and adjacent land use types and density (Moudon and Lee, 2003 p34-35).

Indirect built environment factors may include the presence of other pedestrians, proper walking paths, good shade and lighting (Moudon & Lee, 2003 p21-36). Walkability measures often involve objective, subjective, or a mix of objective and subjective data. Objective measurements use direct field observations, often called a walkability audit or indirect methods, such as the evaluation of secondary data using geographic information system (GIS) techniques. Subjective measurements can involve direct interviews or surveys with pedestrians or potential pedestrians in a study area or indirect methods such as the evaluation of built environment attributes related to perceptual responses, such as design qualities (Ewing et al 2006).

2.6 Safe Routes to School

The Safe Routes to School campaign is aimed at supporting a national reduction in the prevalence of obesity. It pursues this goal by “creating the environment, policy and behavioural

changes" (Pedroso and Ping, 2009, p. 5; cited by Shelling, 2010) necessary to get individuals, especially children, engaged in regular physical activity, through walking and biking for school travel. Safe Routes to School's funding focuses primarily on improvements to the built environment and the elimination of hazards which impede children's safely walking and biking to school. With most scholars (secondary school students) living between 1-3 kilometers away from their schools and the only common mode of travel being walking, with only a few able to cycle, there is a need to make these routes safer. (Alfonso, J.2017.p15).

Shelling (2010.p95-96) argues that, in order for this type of safe routes to school program to succeed, key decision makers in local authorities need to be educated on developing policies that promote walking and a safe environment for students, for example, policies that improve walking for scholars by the need for pedestrian facilities that might be required to enhance walking for scholars.

Infrastructure improvements include, but are not limited to sidewalk improvements, traffic calming, speed reduction improvements, pedestrian and bicycle crossing improvements, on-street bicycle facilities, off-street bicycle and pedestrian facilities, secure bicycle parking facilities, and traffic diversion improvements in the vicinity of schools (Fernandez, 2012, p14).

Several countries that have implemented the Safe Routes to School campaign show that it enabled and encouraged children, including those with disabilities, to walk and cycle to school (Fernandez, 2012, p22). It has also made walking and cycling more interesting among school going children, as it has led to safer and more attractive routes. Basically, a well-organised program of safe routes to school with good planning and implementation leads to improved safety, vehicle reduction and low air pollution in the areas surrounding the schools.

2.6.1 Benefits of walking to School

For the past decade, urban and transportation planners have been trying to embed physical activity in the daily commute to school. Much research has been done on the benefits of walking to school. Studies have found that active transportation, or the act of scholars walking or biking to school, is not directly linked to decreasing childhood obesity (Green et al. 2013, p2-3). Saunders et al. (2013, p9) claim, however, that it does have positive effects on preventing diabetes. However, the study looked only at a single variable contributing to obesity and was

not a holistic health view. Green et al. (2013) found, in a systematic review, that walking contributed to a lower mortality rate among individuals even though it did not have a significant impact on cardiovascular health. In an analysis of groups walking to school, involving 1,843 participants.

2.6.2 Problems with walking to school

Walking to school may have many benefits, but it also comes with its own set of complications. Complications, generally, include safety concerns centred on traffic, crime, and the physical characteristics of the roads, such as the speed limit, road type, and direction of travel (Buckley et al. 2013, p294-300). The literature has examined the factors that contribute to students not actively commuting to school. Ermagun and Samimi (2015, p206), using a three-level nested logit model to explain the motives behind school trips, they found that improving safety could increase walking to school by as much as 60%. Safety is the primary concern of parents in allowing their children to walk to school, making programs such as Safe Routes to School essential.

3 Research Methodology

3.1 Introduction

In this chapter the method which was used to collect and analyse data is discussed. The chapter also describes the target population, the sampling procedure, the sample type, research instruments that were used and the procedure for data analysis.

3.2 Research process design

Having selected the research design, the Figure 3.1 represents the research process followed to complete the study. The process describes all the steps and procedures that were undertaken from the initial stage to the last stage of the thesis. It begins with the research problem; it's based on the author's experience of observing scholars walking to school in the town of Otjiwarongo. The methodology consisted of data collection methods and instruments. With the aid of the methodology, the data was collected from primary and secondary sources. The summary of major findings from the study were made before conclusions and recommendations. recommendations.

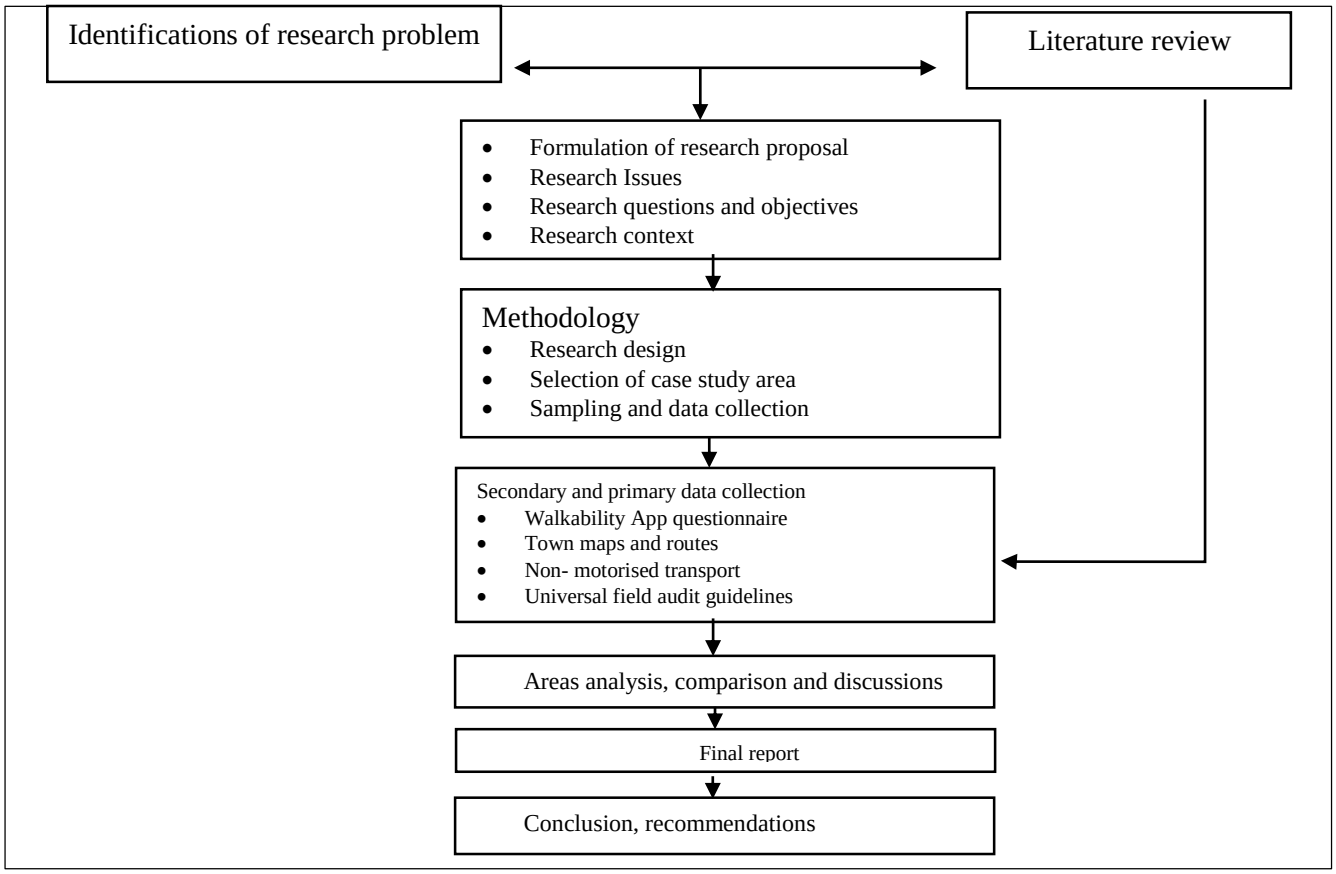


Figure 3-1 Research process design

3.3 Research design

This study used a mixed methods research method, which is a type of research in which a researcher (or team of researchers) combines elements of qualitative and quantitative approaches, (for example, the use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the purpose of breadth and depth of understanding and corroboration. Qualitative research, focuses on interpreting the participants' perspectives (Kenworthy, 1999). Mixed methods research, specifies both the independent and the dependent variables under investigation, as it follows firmly the original set of research goals, arriving at more objective conclusions and testing of hypotheses.

3.4 Study Area

The study was conducted as a case study in the town of Otjiwarongo in Namibia. This area was selected, because the town has some walkability facilities, hence, there is a need for a walkability assessment to be done.

3.5 Target Population and Sample: size and procedure

The target population for this study was school-going children of combined and secondary school learners in the town of Otjiwarongo. 13 learners who walk to school participated in the study and they came from different schools in the town and lived in different suburbs. The reason why only 13 scholars participated is that they were the only ones who agreed to participate in the study. From the total of 13 participants, 6 and 7 scholars came from Otjiwarongo Secondary School and Donatus Secondary School respectively. This was done through random sampling, where everyone in the entire target population has an equal chance of being selected. The routes were allocated to scholars through bowl raffle, where each willing participants' picked some routes that they walked.

Random samples require a way of naming or numbering the target population and then using some type of "raffle" method to choose those to make up the sample. Random samples are the best method of selecting a sample from the population of interest (Mcleod, 2014). Every learner was given a questionnaire, by means of which they indicated what they observed on their specific routes or walking paths, and their responses were treated as confidential. Scholars went through briefing sessions, to inform them exactly of the type of data needed for the study and

the aims of the study. This helped them to give precise and useful data.

3.6 Research instrument

The mixed method study was used to conduct primary and secondary research.

3.7 Primary Data

The information came from the questionnaire developed by the researcher, and the use of maps on mobile phones to trace scholar walking paths to verify that they had indeed walked. The primary data gave the detailed definitions of terms and statistical units used in the study. The questionnaire was designed to find out the reasons why scholars walk, what are the benefits that arise from walking, which routes they used walking to school, how safe these routes were, and what challenges they faced when walking to school. All these questions generated secondary questions, by looking at the comfort, security, safety and infrastructure ratings along the routes they used.

3.8 Secondary Data

The information was collected from various sources like books, and some from published articles, the town maps, that showed the area demarcations and school locations.

3.9 Reliability and Validity of Data

3.9.1 Reliability

Reliability is defined as the quality of consistency or reliability of a study or measurement. A measuring instrument is reliable if it provides consistent results (Kothari, 2004, p75). That means, if the same or a different researcher repeats the study, it should yield the same results. By doing so it improves the reliability of results by standardising the conditions under which the measurement was done. Hence, the researcher designed the directions for measurement with no variation from participants, through a standard questionnaire.

3.9.2 Validity

Validity is the most important criterion and indicates the degree to which an instrument measures what it is supposed to measure (Kothari, 2004, p73). In order to achiever validity, the

researcher ensured that the measuring instrument provided adequate coverage of the topic through the use of a statistically relevant sample of scholars.

3.10 Data analysis and collection

The quantitative data was analysed using the mean analysis. This was done through the adding of ratings from the routes within the same area and dividing by the total possible rating, if the routes could be ranked or rated with the highest rank. Qualitative data were analysed by a reflective analysis. The description and evaluation of the studied phenomena was based on the judgment and intuition of a qualified expert. Participants were required to fill in forms with questions and a set of possible answers. These were given to the participants. While the quantitative focused on scores, numerical where the participants were asked to rank the current areas, for example, 1-5, one being poor and five excellent. Excel was used for data analysis and presentation was done through the use of graphs and charts. The universal access guide and specifically, walking were used as the benchmark to be able to see if the town does have basic requirements for pedestrians.

Each specific route undertaken by scholars was analysed by looking at the findings – what was good and what problems were experienced by the participants. This included the general conditions of the routes. The area or route comparison was done, where different routes used by scholars were compared to each other, basically to have the average general conditions of the whole area. This was done using the municipality geographical residential maps, which showed how the areas were grouped. This enabled the researcher to pinpoint the differences between these areas in terms of walkability.

The research is presented in a written form with the addition of data charts, which represent the researcher's findings. Tables, graphs and network charts were used to illustrate some of the analysed data. This cannot be confirmed, however, until the research data have been analysed.

4 Data analysis and Presentation

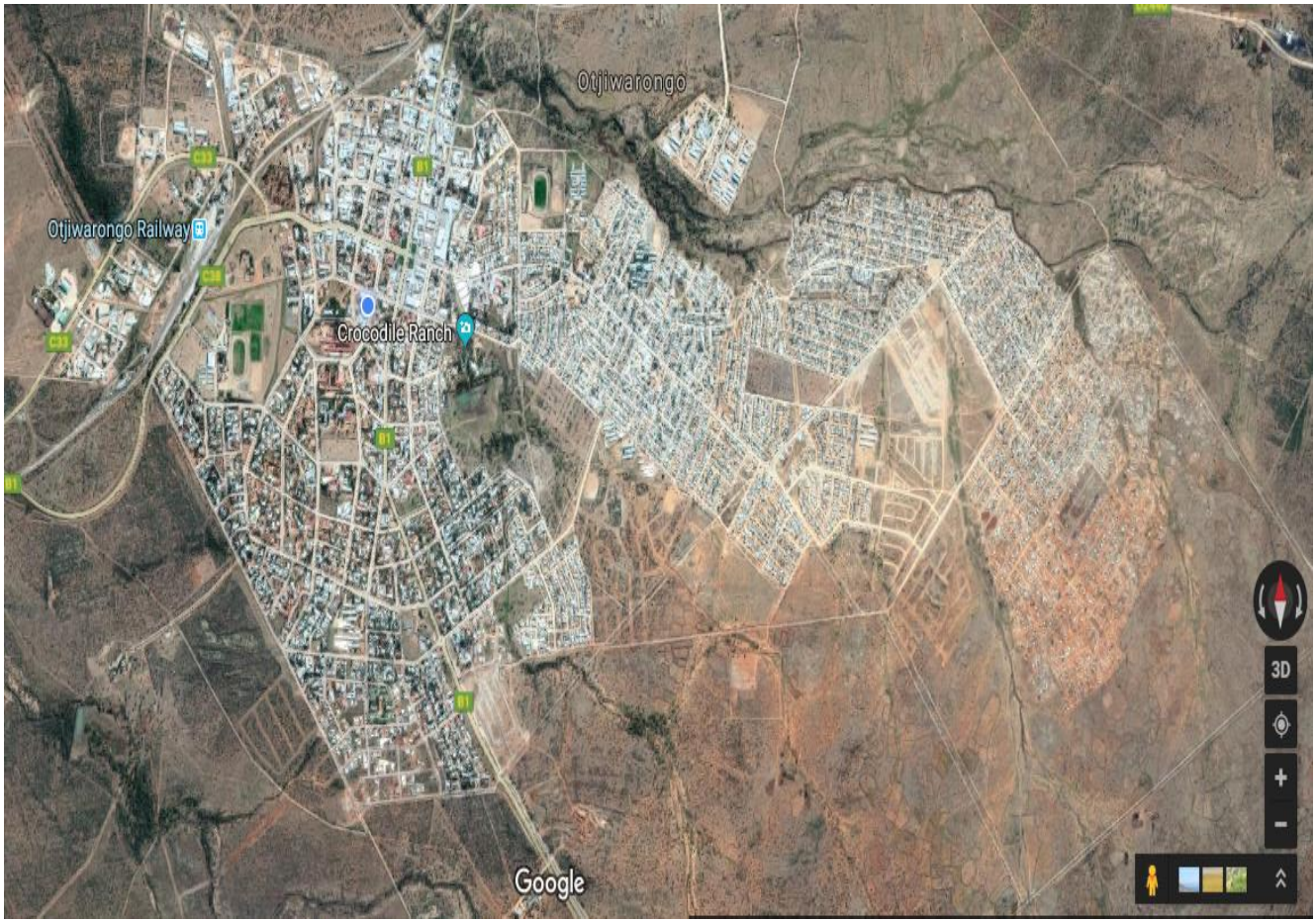
4.1 Introduction

Selection of the picked, but rather a process that has been carefully guided by the key research issue. The town of Otjiwarongo problem for investigation was not straight forward, where a case was simply being chosen for the following reasons:

- Population: The town has a population of 28163 (twenty-eight thousand one hundred and sixty-three) according to national population census of 2011. It's in the top 10 towns with higher populations and a rapid urbanisation rate. The town is geographically centrally located and serves as an interchange for transport industries.
- Rapid housing transformation: The recent establishment of new locations meant an increase in the number of school-going children, hence, it presented a good area in which to investigate the requirements of pedestrian scholars.
- Further, being a resident of the town, gave the author better access to data.

4.2 Area selections

The town has a total of 14 extensions (areas, as shown in Figure 4.1). The study area was divided into two: Central Town, where Otjiwarongo secondary school is located and it is also a mixed use area, where municipal offices, government offices, private companies and shops are found. Orwetoveni, is purely a residential suburb and it is where Donatus secondary school is located. The most common means of transport for scholars are walking and cycling. These areas have high-school scholars, as these two schools are the only ones which offer senior secondary schooling. There are three routes for each school and each selected area has one school. The data is presented by routes within an area and followed by area comparisons.



Source: www.google.com.na/maps/
Figure 4-1 Otjiwarongo Map

4.2 Area one: Central Town

There were seven routes used by scholars. Each route was analysed and the responses of the participants are provided. The routes are named libertine Street route, marketto street route, St george street route, crocodile range route, monitronics colleges route and town square route, for this specific area, together with the names of the streets which the students walked along. The area has two schools, a primary and a secondary school. The schools are located in the town itself, which means that there's dense traffic. The area consists mostly of office buildings, residential buildings and retail business – basically it's a mixed-use area. The area has some traffic lights, speed limit signage and clear road markings. The main national road B1 runs through this area. This road links the northern townships to the capital city and is an extremely busy road.

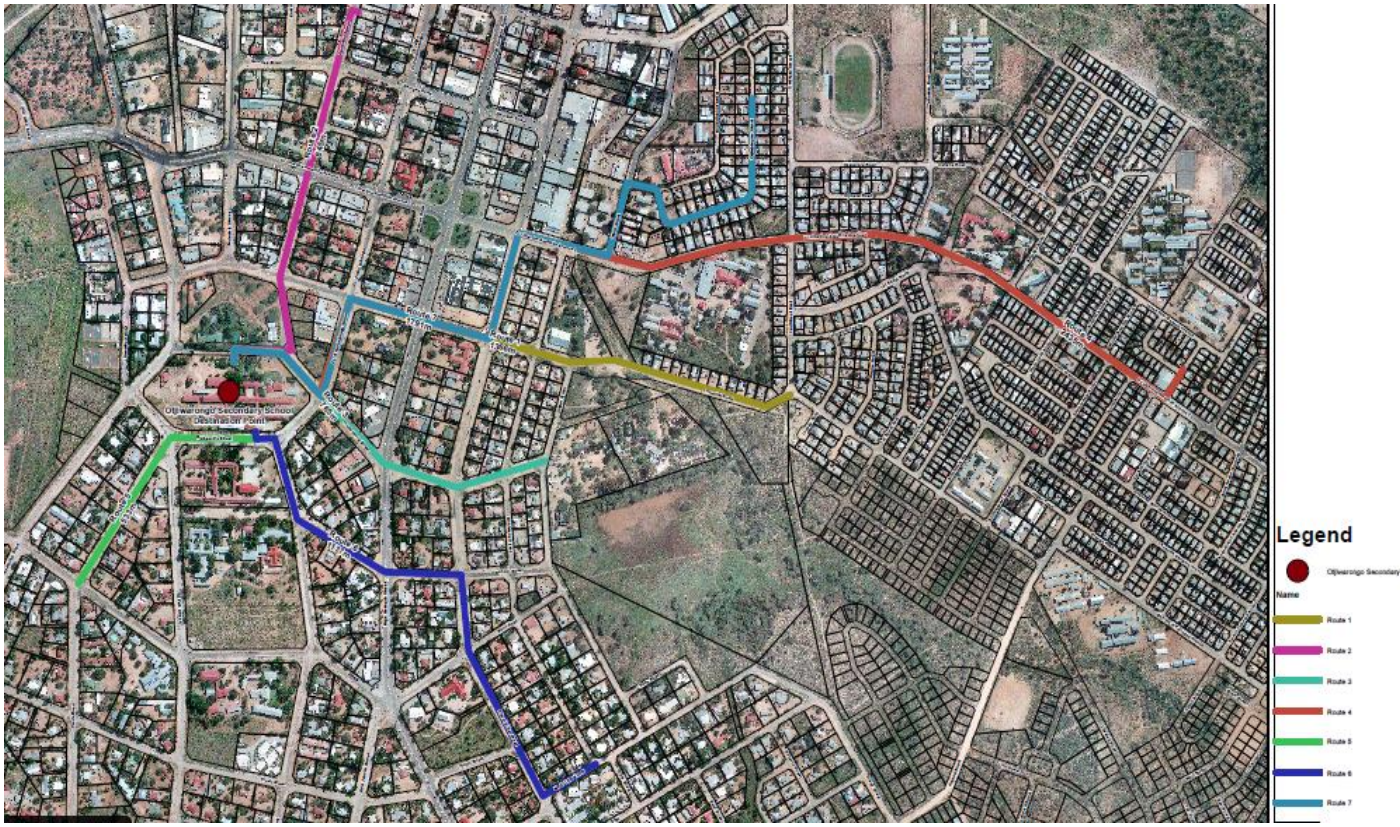


Figure 4-2 Central Town area with the routes used by scholars to Otjiwarongo Secondary School

Figure 4-3 Typical walking path in Central Town area

The Figure 4.3 above shows the typical walking path obstructions faced by scholars on a daily basis. It shows vehicles parked on the walking path, forcing scholars to walk on the roads.

4.2.1 Central Town overall results

The overall results for the town centre are shown in summary form in Figure 4.4 Overall number of results on all criteria.

The figure below shows four types of criteria that were used to determine the walkability of routes for scholars. The fine details of analysis are discussed below under each individual criterion.

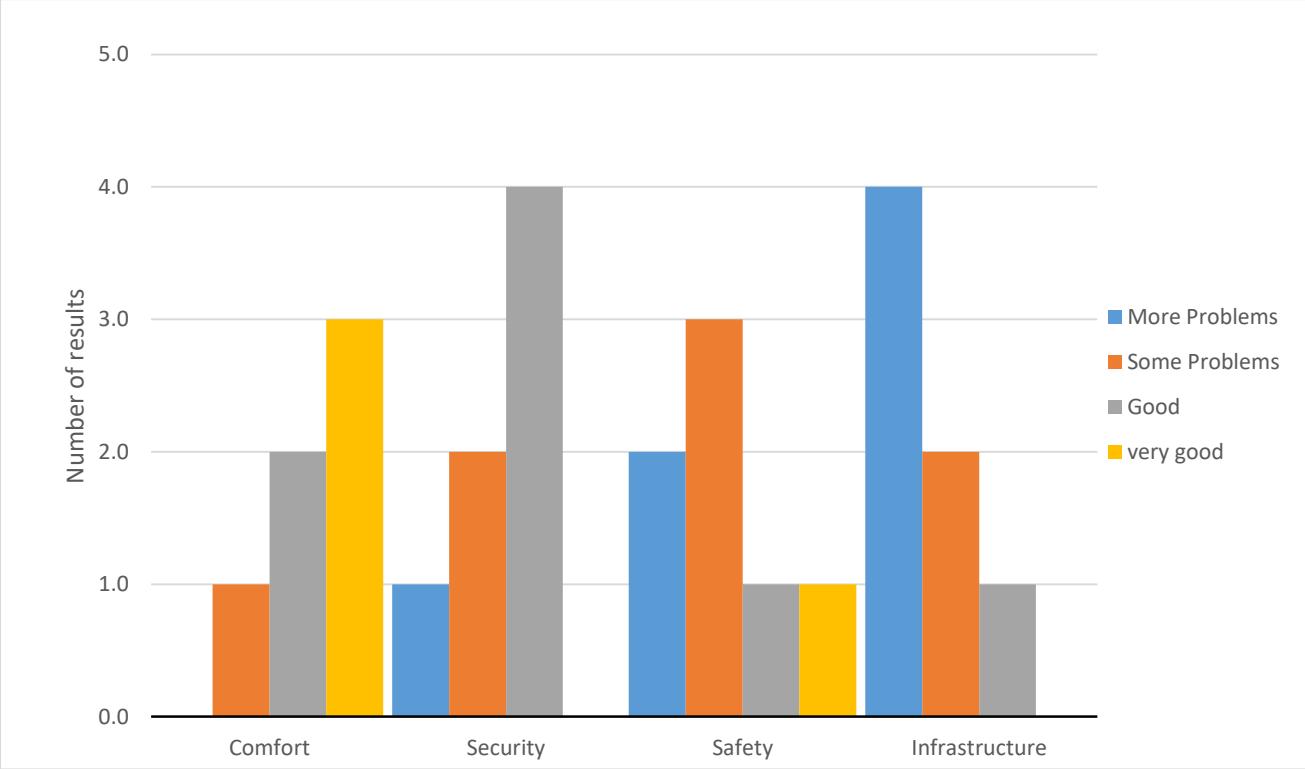


Figure 4-4 Overall number of results on all criteria: central town

4.2.2 Comfort criteria

Scholars were asked to rank the routes they used when walking to school. The comfort criteria focused on how the scholars perceived the routes they used every day when going to school, by looking at how clean the routes were, the maintenance of the walking path and the provision of amenities along the routes. These attributes are based on the Universal Access guideline for pedestrians and are required to be fulfilled to create comfortable walking paths Source needed. They were also asked to identify those problems that they faced when using these routes in the town centre. The results showed mixed responses. First, the overall responses – four of the respondents out of the seven from the centre of town, indicated that the route they used was good by comfortable criteria. This means the route is very good regarding the state of

cleanliness, maintenance of the walking environment, good drainage and very good provision of amenities such as dustbins along the route, as shown below in Table 4.1.

Comfort criteria Ratings	**5 = Excellent**	**4 = very good**	**3 = Good**	**2 = Some problems**	**1 = Many problems**
Cleanliness and Maintenance of your walking environment		3	2	1	1
Degree of path drainage along your route		3	2	1	1
Degree of obstruction along the route		3	2	1	1
Provision of pedestrian amenities such as dustbins and public seating along the route		3	2	1	1

Table 4-1 Central town comfort specific elements respondents' results

One of the participants indicated that the routes used were good. One scholar also indicated that the route used had some problems and again, only one respondent indicated that the routes had many problems. Some problems that came out from these specific criteria in the center of town were, cars parked on the side of the road and on the walking path, and the walking paths were dirty, with huge rocks lying next to the road. Some routes also had drainage problems and dustbins were hardly ever emptied.

4.2.3 Security criteria

Security criteria looked at security features that were available on the routes used by scholars to school. The features that were considered ranged from pedestrian oriented lighting, the level of human activity along the routes and how they felt about their personal security while walking to school. They were also asked about any problems that they normally encountered on their routes to school, that, related to security issues.

Security criteria Ratings	**5 = Excellent**	**4 = very good**	**3 = Good**	**2 = Some problems**	**1 = Many problems**
How much pedestrian oriented lighting is available along your route			4	2	1
Rate the level of human activity along the streets that make up your route			4	2	1
Rate your sense of personal security while walking along your route			4	2	1

Table 4-2 Central town security specific elements respondents' results

Table 4.2 above, shows how respondents rated the Central Town area on specific elements. These results were later used for overall ratings on the security features of Central Town. Four of the scholars indicated that there was adequate security provision on the routes they used in the Central Town area. The fact that, the routes had good lighting and a good level of human activity made them feel safe when walking to school. Two of the respondents indicated that, there were some security problems on the routes they used. Lastly, one participant felt that there were more security problems on the routes he/she walked.

Problems identified in this area were, some routes had few people walking along them, and this made the scholars feel afraid they would be attacked and have no one to rescue or assist them. The second problem associated with the routes, was vehicles which were sometimes driven on the paved walking path. Thirdly, some of the street lights were not working and scholars were forced to walk in the dark early in the morning. Lastly, on some routes there were street kids and they always carried sharp objects for use as offensive or defensive weapons and this contributed to the insecurity of the scholars. They were scared to use these routes, because of the likelihood of being attacked.

4.2.4 Safety Criteria

Safety criteria look at the number of safe road crossings provided along routes, e.g. zebra crossings, pedestrian crossings and intersections controlled by traffic lights. Other issues considered were the traffic volume on these routes, the perceived speed of the vehicles and the scholars' sense of safety from injury caused by motorised transport.

Safety yielded an equal responded on the good and very good rating. The figure above clearly indicates that only two respondents felt that, the routes they used rated 'very good' and 'good'.

This showed that the routes they took to school had some pedestrian crossings, vehicles were driven at minimum speed and they felt safe from the risk of injury by vehicles. Three scholars in this area responded that their routes had some problems, and the last two scholars responded that their routes had many problems. The table below indicates how the scholars responded to questions on safety elements. The results formed the overall safety feature rating for the central town. The numbers represent the participants, meaning each number is the number of scholars' ratings for each element.

Safety Rating	***5 = Excellent***	***4 = Very good***	***3 = Good***	***2 = Some problems***	***1 = More problems***
Rate the provision of safe crossings along your route e.g. zebra crossings/ pedestrian malls/signalized intersections		1	1	3	2
Rate your sense of safety from injury caused by motorised transport		1	1	3	2
Give a rating for the amount of moving motorised transport along your walking route		1	1	3	2
Give a rating of how you perceive the speeds of motorised transport along your route		1	1	3	2

Table 4-3 Safety specific elements respondents' results

The problems highlighted were, first, most of the vehicles were driven at high speed, especially taxis. Second, some routes don't have zebra crossings or traffic light controlled intersections.

4.2.5 Infrastructure criteria

This looks at the quality of the pedestrian environment, which is key to encouraging scholars to walk. It includes the connectivity of the walking path, a good pedestrian network, the quality of the path and fine grained land use patterns.

Below, Figure 4.4: The number of results on all criteria, shows that four of the scholars indicated the routes they use have many infrastructure problems, compared to only one respondent who indicated that the routes he/she used were good. Still, Figure 4.4 shows that two respondent indicated that, the routes they used had some problems regarding infrastructure criteria. This shows that the routes within this area have poor or no walking space along the

route, which means scholars have to share the roads with vehicles. The quality of the pavement material is also a concern, as the scholars indicated that some routes had damaged paving which had recently been replaced. “Table for 4.4 Infrastructure specific elements respondents’ results” below, shows what elements were looked at regarding infrastructure features and how they were rated by the scholars.

Infrastructure Criteria Rating	***5 = Excellent***	***4 = Very good***	***3 = Good***	***2 = Some problems***	***1 = More problems***
Rate the quality of pavement material			1	2	4
Rate the provision of walking space along the route			1	2	4

Table 4-4 Infrastructure specific elements respondents’ results

Another problem mentioned is the walking path space/size. Basically, scholars have drawn attention to the space being too small for walking and the lack of open spaces between the pavements.

4.2.6 Response to general questions Central Town

The scholars were asked three open-ended questions, first, what is the most important factor associated with choosing a route? Second, how often do you walk to a public transport area? And last, do they have access to motorised transport for their trip to school? Their responses were summarised in Table 4.5 below.

Scholars and respondents Questions	Scholar 1	Scholar 2	Scholar 3	Scholar 4	Scholar 5	Scholar 6	Scholar 7
What is the most important factor associated with choosing this route?	Safe to walk	Shorter, friends use the same	Safe, lights availability and friends	Near my home	Shortest	Safe to walk	Short
How often did they walk to a public transport area?	Not often	Not often	Once or twice per week,	Not at all	Depends if late	Not often	Not all
Do they have access to motorised transport for their school trip?	Yes- but prefer walking	No	No	Yes	Yes – I can take taxi	No	Yes

Table 4-5 Respondents on general questions : Central Town

4.3 The summary of results: Orwetoveni

The overall outcome of Central Town area, shows mixed results, infrastructure criteria ranked highly with more problems, this means most of the routes undertaken have poor walking path and not paved. The security criteria were rated highly good on most of the routes, even so some have few problems. Some routes used by scholars had some problems and the only criteria rated very good was the comfort criteria.

4.4 Area Two: Orwetoveni

The area is mainly a residential area, with only one office building. The area has a main road that passes through the township, from South to the North in the direction of the town. The area has three schools, namely one secondary, one primary and a pre-primary school. The primary and secondary schools are separated only by a fence. The schools cater for all scholars in the town who want to enroll with them and have scholars from other suburbs of the town as well.

The assessment for Orwetoveni was done by six scholars. The results per criteria and overall group area are shown below on “Figure 4.7 Orwetoveni overall results”. The ratings range from 1, having many problems, to 5, being excellent. The area map and the individual route walking path can be seen in the Figure 4.5 “Map of Routes used by Scholars in Orwetoveni” below. The analysis was done by looking at individual criteria and their results, while the overall grouping of these criteria is also shown in Figure 4.7 “Orwetoveni overall results”.

Figure 4-5 Map of Routes used by Scholars in Orwetoveni

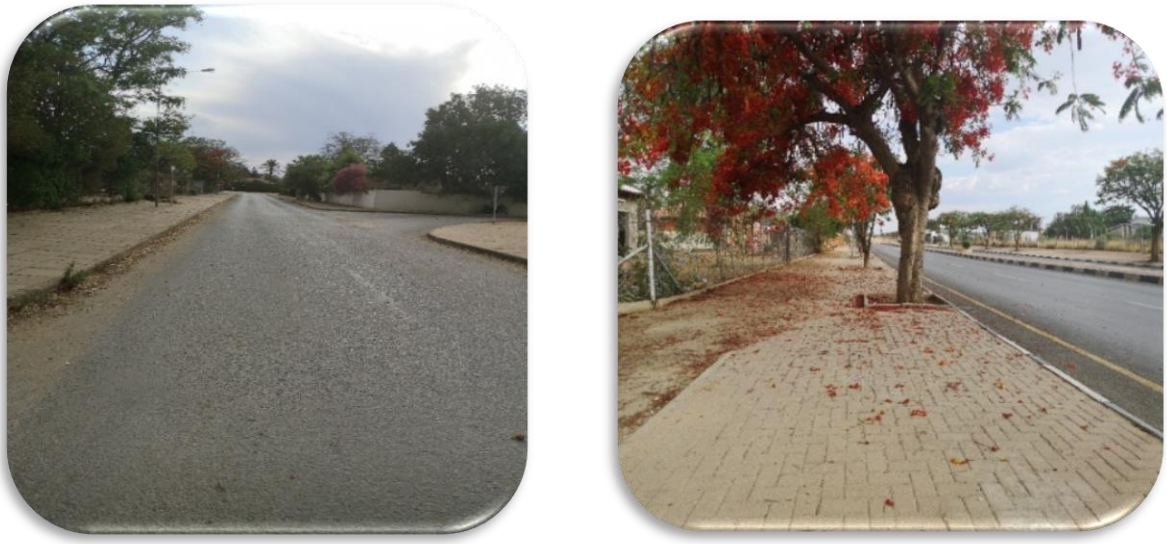


Figure 4-6 Typical walking path in Orwetoveni

Figure 4-7 Scholars walking from school

Figure 4.6 Typical walking path in Orwetoveni:Orwetoveni above shows the typical condition of the walking path on some of the routes used by scholars when walking to school in the Orwetoveni area. The figure on the right-hand side, clearly shows poor maintenace of a walking path and on other routes, there were trees planted in the midddle of the walking path, making it didfficult for two scholars to walk abreast.

4.4.1 Orwetoveni Overall resluts

The Figure 4.7 “Orwetoveni Overall Results”, represents all the results from scholars for the Orwetoveni area. A finer analysis follows, where each criterion’s results are discussed in detail in paragraph 4.3.2.

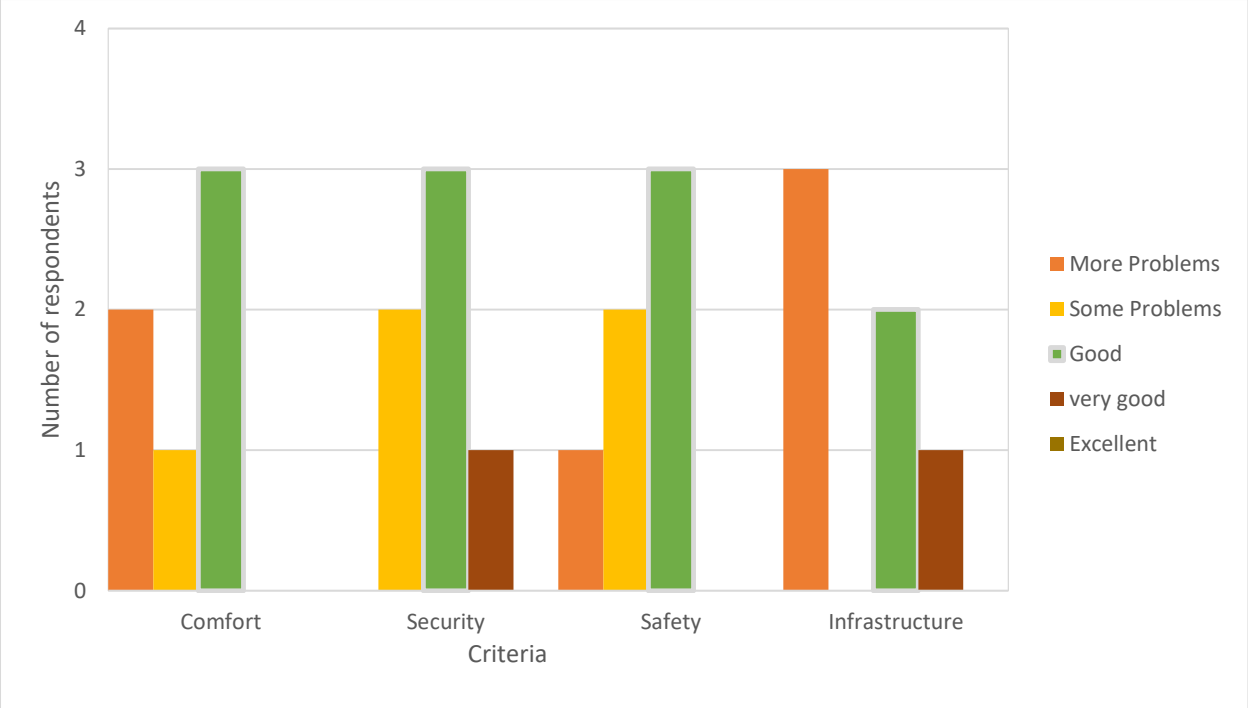


Figure 4-8 Orwetoveni Overall Results

4.4.2 Comfort criteria: Orwetoveni

This criterion, focused on how scholars felt when using these routes, with particular regard to proper drainage and good walking path connectivity. The Figure 4.7 "Orwetoveni Overall Results" clearly shows that three scholars felt that the routes they used to school were good. Two scholars indicated that, their routes had more problems and only one respondent indicated that he/she felt that the route he/she used to school had serious problems. The routes were clean, maintenance was done on the walking paths, and some amenities were provided along their routes, for example dustbins.

Comfort criteria Ratings	**5 = Excellent**	**4 = very good**	**3 = Good**	**2 = Some problems**	**1 = Many problems**
Cleanliness and Maintenance on your walking environment		3	2	1	1
Degree of path drainage along your route		3	2	1	1
Degree of obstruction along the route		3	2	1	1
Provision of pedestrian amenities such as dustbins and public seating along the route		3	2	1	1

Table 4-6 Orwetoveni Comfort specific elements respondents' results

The problems highlighted within these routes are; (1) there were a lot of paper, plastic bags and tins lying next to the roads, (2) the walking paths were not paved and (3) had poor drainage. Basically, students tend to take the shortest routes to and from school if they have choices and do not have access to public transport, that is, taxis.

4.4.3 Safety Criteria: Orwetoveni

Safety criteria looks at how safe a scholar feels when walking to school, by looking at pedestrian crossings, vehicle speed limit signs and traffic-light controlled intersections.

Table 4.7 "Orwetoveni Overall Results" shows that, three scholars indicated that the routes they used in this area were safe, as it has some zebra crossings, has a moderate amount of motorised transport movement and vehicles are driven at lower speeds. Basically, the routes run through residential areas. While two of the respondents feel that their routes have some problems, hence, they ended up giving poor ratings on these criteria. Lastly, only one participant indicated that the route used had a lot of problems, with regard to the items they were required to measure. The table below, shows clearly the attributes on safety and how the scholars responded to them. These contributed to the overall rating of safety features for Orwetoveni.

Safety criteria Rating	**5 = Excellent**	**4 = Very good**	**3 = Good**	**2 = Some problems**	**1 = More problems**
Rate the provision of safe crossings along your route e.g. zebra crossings/ pedestrian malls/signalized intersections			3	2	1
Rate your sense of safety from injury caused by motorised transport			3	2	1
Give a rating for the amount of moving motorised transport along your walking route			3	2	1
Give a rating of how you perceive the speeds of motorised transport along your route			3	2	1

Table 4-7 Orwetoveni Safety specific elements respondents' results

The problems highlighted by the participants were as follows: (1) some routes did not have pedestrian crossings, (2) vehicles sometimes did not stop for scholars at pedestrian crossings.

(3) There were no speed humps to reduce vehicle speeds. Lastly, as shown in Figure 4.8, there was no paving for pedestrians on the sidewalks and this forced them to walk on the main road which could have caused accidents.

Figure 4-9 No paved sidewalks and speed humps in some routes used by scholars

4.4.4 Security Criteria: Orwetoveni

Security is comprised of the following: the availability of pedestrian oriented lighting on routes, the level of human activity along the street, including open markets, street vendors and other pedestrians.

The Figure 4.7 “Orwetoveni overall results”, illustrates that, the results are better when it comes to the security of the routes in this area. Of the six respondents, three indicated that their routes had good security. This means the routes had better lighting and a high level of human activity. The scholars felt safe being surrounded by people. As seen in figure 4.7, two scholars responded that their routes had problems and they felt insecure to using these routes at all. The map of Orwetoveni, shows that route 1, is at the end of a suburb and this, with the lack of lighting, constituted a high security risk for scholars. Only one of the scholars who uses the route numbered 4 in figure 4.5 felt that the route was very good in terms of security. Table 4.8 below, indicates specific attributes that were considered during the study and how many scholars rated these attributes.

Security criteria Ratings	**5 = Excellent**	**4 = very good**	**3 = Good**	**2 = Some problems**	**1 = Many problems**
How much pedestrian oriented lighting is available along your route		1	3	2	
Rate the level of human activity along the streets that make up your route		1	3	2	
Rate your sense of personal security while walking along your route		1	3	2	

Table 4-8 Orwetoveni Security specific elements respondents' results

Several problems were identified by the scholars: (1) a walking route that doesn't have paved walkways is not safe as it forces them to walk along the main road. (2), the routes that they use sometimes don't have proper lighting creating a favorable environment for muggers, who frighten the scholars.

4.4.5 Infrastructure criteria: Orwetoveni

Infrastructure looks at the availability and quality of walking paths within the study area. This comprises a good network of pedestrian connectivity and sufficiently wide walking paths.

This area Orwetoveni, is dominated by poor infrastructure. Three scholars have shown that the routes they used were poorly maintained and there was no walking space provided along the routes. This is shown in Table 4.9 "Orwetoveni overall results", where two of the respondents indicated that they felt that the routes they used were good and only one indicated that the route he/she used was in very good condition. This means the walking paths were wide enough for people to move and were well maintained. The municipality is busy with some walking path construction projects in some areas of the town.

Infrastructure criteria rating	**5 = Excellent**	**4 = Very good**	**3 = Good**	**2 = Some problems**	**1 = More problems**
Rate the quality of pavement material		1	2		3
Rate the provision of walking space along the route		1	2		3

Table 4-9 Orwetoveni Infrastructure specific elements respondents' results

Table 4.9 above shows mixed ratings, as 3 scholars felt the quality of materials and walking space on their respective routes had more problems, while 2 scholars responded by rating the pavement material and walking path to be good, and only 1 respondent rated these attributes as very good.

Some problems identified were, narrow walking spaces; and a lack of paved walking and cycling spaces.

4.4.6 Response to open general questions.

The scholars were also asked a few open ended questions, and their response are shown below in Table 4.10. The question was intended to find out what they considered when choosing the routes, they used and whether they did have access to motorised transport.

Scholars and respondents / **Questions**	**Scholar 1**	**Scholar 2**	**Scholar 3**	**Scholar 4**	**Scholar 5**	**Scholar 6**
What is the most important factor associated with choosing this route?	Shortest and safe	Shorter, a lot of people on this route	Safe, pedestrian oriented lighting	Short and safe	Shortest to school	Safe and crossing intersections
How often do you walk to a public transport area?	Not often	Rarely	Not all	Not often	Only sometimes	Not often
Do you have access to motorised transport for your school trip?	No, taxis are not willing to drive to this area	No	No	Yes	Yes – I can take a taxi	Yes

Table 4-10 Respondents on General Questions for Orwetoveni area

4.5 The summary of results: Orwetoveni

The overall results show that walkability in the Orwetoveni area is not poor in the first three categories of criteria, namely, comfort, security and safety. The area is generally good on walkability based on these criteria, while on infrastructure the area is at its lowest, having many problems.

The big concern of the area was infrastructure, as the infrastructure ratings were, for the most part, low. This could be attributed to the fact that, as the town grew, more students from other suburbs crossed over to other areas for school. In the end, the routes that were not initially planned for walking mobility tended to be used by scholars, as they were usually shortcuts to school. The most common shortcomings in this area, were the absence of paved walking paths, narrow walking spaces, which in the end forced scholars to share the road with motorised transport. Figure 4.9 on the next page clearly shows this occurrences, and they tend to walk in the road.

Figure 4-10 No paved walkway Orwetoveni

Comfort is the second criterion to be associated with problems in this area. Basically, most of the concern is regarding the maintenance of pavements and the cleanliness of the walking path. The area's walking paths are not being maintained at all and this makes walking unpleasant for scholars in particular, and pedestrians generally. Moreover, the area has poor drainage, lacks seating along the routes and has dustbins that are very seldom emptied.

Security is good in general, as it has been rated as good by three scholars. Even so, they don't feel completely safe because of poor pedestrian oriented lighting and poor human activity. This is the reason why the infrastructure ratings are low. Poor infrastructure has a direct impact on all these criteria because no one can feel secure walking in an area where there is no path or streetlights at night.

4.6 Area Comparison

The two areas we compared by looking at scholars' walking assessment in Otjiwarongo. Observing at and comparing these two areas allowed me to have a general understanding of walkability in these areas. This part of the research focuses on the comparison of each of the criteria in one area with the same criteria in another. This was needed to find out which of the two areas provides an environment which is more conducive to walking for school going pupils.

The figure below shows the results per area paired with each other. The results that have been paired for easy appraisal here, are only the three which attained an upper rating. This means only a rating/score of good, or 3 or more was used. The numbers were added together and given as an overall score/rating for these areas. Figure 4-10: Results Comparison; Central Town and Orwetoveni shows the differences between these two areas using the same criteria.

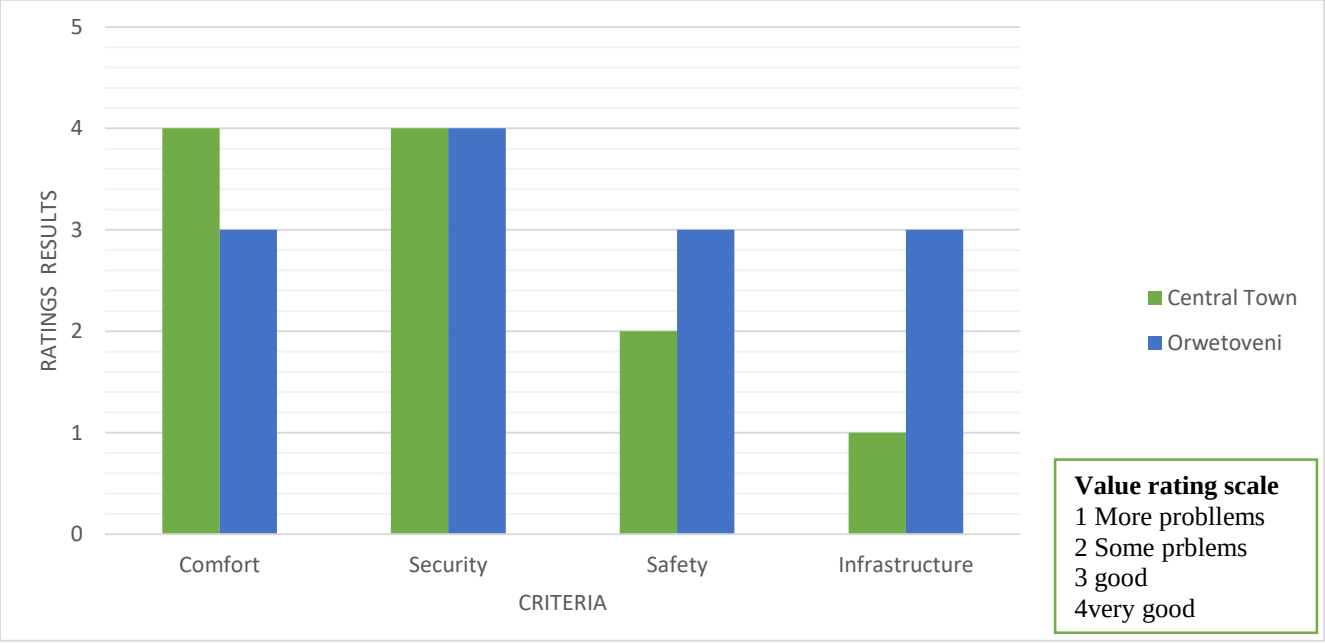


Figure 4-11 Results Comparison: Central Town and Orwetoveni

Central Town, is rated better on the criteria of comfort, with a total of 4 scholars rating the area with a score of "good and above", compared to the Orwetoveni area, which had only 3 scholars who rated the walking routes with good and above scores. The reason the Central Town, has well-maintained walking paths, and mostly paved sidewalks, is it's where most people pass through. The municipality of Otjiwarongo therefore provided good walking paths with proper drainage.

All the areas gave an equal rating of good and above scoring on the security criteria because the walking paths were well maintained. All areas had 4 scholars who indicated that security-wise the areas rated "good and above". The routes being used in these areas had enough lighting, and a high level of human activity. For the purposes of walking this made the scholars feel protected, even so, some routes might have problems.

On the safety criteria, Orwetoveni is quite rated "good", compared to the Central Town. The 3 scholars from Orwetoveni, indicated that the area was good and above on the ratings, compared to 2 from the Central Town. Orwetoveni has some zebra crossings and a moderate amount of motorised transport. The vehicles drive at lower speeds, because they are in a residential area. This increases the scholars' safety when walking to school. When compared with the routes in Central Town, which do have some controlled crossings, but the volume and speed of vehicles are quite high. There are some barriers on the walking path. This was done to prevent vehicles parking on the sidewalk, but it tends to negatively affect the free movement of walkers and cyclists on the walking footpath.

The last criterion was infrastructure. Orwetoveni still scored higher than the Central Town. Three participants rated it "good and above", while only one did for the Central Town. The main reasons given were the proper maintenance of walking paths and paths sufficiently wide to allow pedestrians to walk two abreast. However, some routes were poorly rated because they had narrow spaces and no paved walking spaces in this area. The routes in Central Town had poor, or no walking space along the routes. The main problems in this area were roads shared with vehicles. The quality of the pavement material was also a concern, as the scholars indicated that it was part of the problems on routes.

4.7 Conclusion

Overall, the results suggested that the walking path conditions along some walkable routes for scholars in the municipality of Otjiwarongo Town needed major improvements. Some routes were rated as expected, meaning just merely walking through these routes, there are far better, they have paved walkways, better pedestrian visibility. While the results for other routes were surprising, such as routes within Central Town, that were expected to be thought much safer when compared to suburban routes. These findings are discussed further in the concluding chapter.

5 Conclusion and recommendations

5.1 Introduction

This chapter draws conclusions regarding the walkability of routes for scholars in the town of Otjiwarongo. This includes the routes they use to school, walking path conditions for these routes and the perceptions of a pedestrian on the walking environment. This chapter also makes recommendations for improving the walkability of routes for scholars within the town of Otjiwarongo. Methodological reflections on the results and conclusions are made and lastly, additional research areas are suggested.

The problems (including conflicts with motorised modes of transport) that scholars face when walking to school

The two areas, Central Town and Orwetoveni each have different street layouts and different available infrastructure which affect walkability.

Central Town, is characterised by mixed results regarding the criteria looked at. The area routes undertaken by scholars were found to be clean, well-maintained walking paths, with good drainage and good amenities and they are only available to a certain extent within the routes undertaken during the study – mostly on the main street. On the security criteria, the Central Town area was rated better than Orwetoveni, due to the fact that, it had some proper lighting along the walking routes and had a high level of good human activity. This contributed to scholars' feeling that security was good on these routes. However, some routes had fewer pedestrians, and this made the scholars feel insecure about using these specific routes because they were afraid of being attacked. It has been seen that most routes or streets that are not regarded as main streets have poor streetlights and vehicles are sometimes driven and parked on paved walking paths.

The safety rating for Central Town area was poor. It was found that vehicles were driving at high speed, especially taxis, and these exposed scholars to the risk of collision and injury which made them afraid to use these routes to school. Some routes were rated good because they had pedestrian crossings and traffic-light-controlled intersections, but the majority of respondents rated the centre of town poorly on safety.

Regarding infrastructure, Central Town area was rated poorly and only 1 scholar rated the routes taken to be good. The routes within this area had poor or no walking space along the routes and available only to a certain extent. This meant that in certain areas they needed to share the roads with vehicles. The quality of the paving in the area was poor, the walking spaces were narrow and had undeveloped spaces between them.

The main factors that contributed to a low rating for Central Town, were safety, security and infrastructure, making it the lower ratings in these two areas, scoring 2 out of a possible 5 maximum ratings per criteria.

The last area is Orwetoveni, the area has better streets and adequately wide sidewalks on each side of the road. However, there were some streets that didn't have sidewalks at all. The area has good walkability in all the criteria considered. The area has a good rating, meaning most of the respondents rated this area as good and above. The only criterion its score was equal to that of the centre of town was on infrastructure. Out of 6 participants, 3 rated the infrastructure poor and the other 3 rated it good and above good. Hence the area rating on average was 3 out of a possible 5.

The overall walkability of the areas

The results showed that the walkability within these areas, ranged from poor to average, and this provided risks to scholars within these two areas. All in all, the common criteria with poor rating in both Central Town and Orwetoveni was infrastructure and this had a direct impact on other criteria, for example, safety, as scholars' were forced to walk on the road and share it with vehicles. Low rating for these areas could be attributed to poor sidewalk continuity, no pedestrian crossings and vehicles being parked on the sidewalks.

Orwetoveni had good walkability compared to Central Town, basically, because Orwetoveni is still a newly developed area and has been designed to suit the modern way of living.

5.2 Recommendations

This section presents the recommendations for improving the walking environment in Otjiwarongo and other towns in Namibia. This ranges from policy recommendation to planning and transport. Below are some suggested recommendations:

➢ There is a need for the formulation of a solid Non Motorised Transport (NMT) policy to create a safe and pedestrian-friendly transport system and roads environment for pedestrians and cyclists. The policy again should aim to Improve the pedestrian network and environments of Otjiwarongo.

Without a policy that focuses on pedestrians alone, which makes the local authority provide the community with a good walking environment the interests of pedestrians will be neglected. In most cases, pedestrian issues are normally addressed as a part of other municipal policy rather than a stand-alone policy. This situation results in a failure to cater to the requirements of pedestrians.

The following are the recommendations that the Municipality of Otjiwarongo should pursue through policy development:

- Promote mixed land use and compact development: Urban planners need to change their mindset from zoning residential areas based on fixed land use categories to mixed land use with planned integration of some combinations of residential, retail and recreational areas.
- Improve pedestrian safety measures: The road should be improved to control the speed of vehicles. This may include the use of speed humps or narrowing the road in residential areas. Road signs and markings for pedestrian and public transport facilities must be provided to guide and warn all road users about the presence of pedestrians and public transport activity and to regulate public transport and pedestrian behaviour. Typically, road markings and signage are provided at pedestrian crossings, along footpaths, along cycle paths / lanes as warning signs to motorists and to guide pedestrians and cyclists. The Road Traffic and Transport Act of 1999 (Act 22 of 1999) was enacted to provide for the establishment of the Transportation Commission of Namibia, for the control of traffic on public roads, the licensing of drivers, the registration and licensing of vehicles, the control and regulation of road transport across Namibia's borders; and for matters incidental thereto.
- Non-motorised infrastructure roll-out as part of new development: developers must incorporate into their development the non-motorised transport related infrastructure required to mitigate the impact expected from new pedestrian desire lines formed. This must be considered when undertaking Transport Impact Assessments for developments.

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7 Appendix

7.1 The Walking Audit / Questionnaire

Introduction.

The information obtained will be used solely for this study only and all participants will remain anonymous. Please complete the below information and answer the questions that follow.

Demographic

School…… Grade……..

Routes undertaken…… Age…….

Gender……

Walkability Route rating

Read carefully before you begin your walk (Instructions)

As you walk the specific route, complete the checklist below by giving an overall rating to each item. Please use 1-5 (low to high) walkability rating scale below to rate the various elements of the checklist. In rating each checklist item, consider the overall condition of the area and note the problems within the specific route.

Walkability rating scale				
5= Excellent	*4= very good*	*3= good*	*2= some problems*	*1= many problems*

Comfort Features

Ratings	*5= Excellent*	*4= very good*	*3= good*	*2= some problems*	*1= many problems*
Rate the cleanliness and maintenance of your walking environment					
Rate the degree of path drainage along your route					
Rate the degree of how free is the route from obstruction					
Rate the provision of pedestrian focused amenities such as dustbins and public seating along the route					

Specify problems experienced?

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.....
.....

Safety Features

Ratings	*5= Excellent*	*4= very good*	*3= good*	*2= some problems*	*1= many problems*
Rate the provision of safe crossings along your route e.g. zebra crossings/ pedestrian malls/signalised intersections					
Rate your sense of safety from injury caused by motorised transport					
Give a rating for the amount of moving motorised transport along your walking route					
Give a rating of how you perceive the speeds of motorised transport along your route					

Specify problems experienced?

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Infrastructure Features

Ratings	*5= Excellent*	*4= very good*	*3= good*	*2= some problems*	*1= many problems*
Rate the quality of pavement material					
Rate the provision of walking space along the route					

Specify problems experienced?

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Security Features

Ratings	*5= Excellent*	*4= very good*	*3= good*	*2= some problems*	*1= many problems*
How much pedestrian oriented lighting is available along your route					
Rate the level of human activity along the streets that make up your route					
Rate your sense of personal security while walking along your route					

Specify problems experienced?

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.....

General questions

What is the most important factor associated with choosing your route?

_____
_____

_____
_____

How often do you walk to public transport in this area?

_____
_____
_____
_____

Do you have access to motorised transport for this trip?

_____
_____
_____

7.2 Parent concern letter

P. O. Box 560
Otjiwarongo
Namibia
6 March 2018

To whom it might concern

I'm here do by guarantee Chika Mavuna (the Researcher) the permission to work with our school going children on his dissertation. I have been briefed on his intended topic and the reasons for him conducting this study, the methods of data collections, which will be questionnaires.

All the responses will be strictly treated with confidentiality

Regards

Name CARIN GERTSES Date 6 March '18

7.3 Ethics Clearance letter

Application for Approval of Ethics in Research (EIR) Projects
Faculty of Engineering and the Built Environment, University of Cape Town

APPLICATION FORM

Please Note:
Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) of the University of Cape Town is required to complete this form **before** collecting or analysing data. The objective of submitting this application prior to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the **EBE Ethics in Research Handbook** (available from the UCT EBE, Research Ethics website) prior to completing this application form: http://www.ebe.uct.ac.za/ebe/research/ethics/

APPLICANT'S DETAILS		
Name of principal researcher, student or external applicant		Chika Mavuna
Department		Civil Engineering
Preferred email address of applicant:		Cmavuna@yahoo.com
If Student	Your Degree: e.g., MSc, PhD, etc.	MPhil
	Credit Value of Research: e.g., 60/120/180/360 etc.	60
	Name of Supervisor (if supervised):	Associate Professor Marianne Vanderschuren
If this is a research contract, indicate the source of funding/sponsorship		no
Project Title		Walkability Assessment for school going children case study: Otjiwarongo Town –Namibia

I hereby undertake to carry out my research in such a way that:

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

SIGNED BY	Full name	Signature	Date
Principal Researcher/ Student/External applicant	Chika Mavuna		01 Mar 2018

APPLICATION APPROVED BY	Full name	Signature	Date
Supervisor (where applicable)	Associate Professor Marianne Vanderschuren		01 Mar 2018
HOD (or delegated nominee) Final authority for all applicants who have answered NO to all questions in Section1; and for all Undergraduate research (including Honours).	Dyllan Randall		16 May 2018
Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions.			

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