Perceptions of teachers on the implementation of the waste management hierarchy within secondary schools

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PREFACE AND ACKNOWLEDGMENTS

"There is no such thing as 'away'. When we throw anything away it must go somewhere."

~Annie Leonard~

Waste management is an area requiring global attention. The waste management hierarchy aims at reducing the amount of waste disposed to landfill, with reuse, recycling and recovery of waste being regarded as more favourable options. Human behaviour plays a very important role in implementing the waste management hierarchy, and more success is achieved when positive behaviour is well-entrenched. One way of entrenching positive behaviour is by introducing good practices at an early age. This may be done by exposing learners to responsible waste management practises at a primary and secondary school level. Against this background, this research aimed to determine perceptions of the implementation of the waste management hierarchy at a secondary school level. Since the North-West University does not encourage research on minors, secondary school teachers were selected as research participants to achieve the aim of the research.

I would like to thank God Almighty for the strength and power to make my study possible. To my wife and my two sons thank you for your continuous support and encouragement.

I would like to extend my deepest gratitude to Doctor Claudine Roos for her constructive supervision and her invaluable guidance and constant motivation in my studies.

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ABSTRACT

Education plays an important role towards improved waste management, and may influence the implementation of national policy objectives, such as the waste management hierarchy. This research aimed to determine the perceptions of teachers in the implementation of waste management hierarchy within South African schools. The research followed a case study approach, focusing on secondary schools in the Ekurhuleni North District in Gauteng. Interviews were conducted with 85 teachers from 29 secondary schools to explore their perceptions on the implementation of the waste management hierarchy. The research objectives specifically focused on understanding (i) knowledge and level of implementation of the waste management hierarchy at secondary schools; and exploring (ii) opportunities and (iii) challenges towards implementing the waste management hierarchy at these schools.

The results show that schools generate waste streams (such as paper, plastic and cans), with the potential to be moved "up the waste management hierarchy". The majority of waste generated at sampled schools is sent to landfills (86%) and more than half of the schools (55%) do not practice any separation of waste. When teachers were asked about their perceptions of the concept "waste management hierarchy", divergent opinions existed about what it entailed. All of the teachers interviewed indicated that they would support the implementation of the waste management hierarchy at their schools, because they realised the benefit towards keeping the environment clean, saving resources and contributing to the education of their learners. Only 27% of the respondents believed that their schools were doing enough to promote the waste management hierarchy, while a significant number of teachers (73%) were of the opinion that their schools are not doing enough to promote the waste management hierarchy in schools. Teachers suggested that education (32%), more bins (35%), campaigns focused on waste management (20%) and administrative support (13%) were necessary to promote the waste management hierarchy at schools. About half of the respondents perceived secondary school teachers to have adequate knowledge of the waste management hierarchy. Respondents reported that school teachers impart knowledge to their learners on prevention of pollution, reuse and recycling, conservation of resources, and business opportunities from waste – which relate to the waste management hierarchy. All of the teachers interviewed reported that they would be willing to participate in programmes, forums or activities towards implementing the waste management hierarchy at their schools.

Opportunities identified by school teachers towards implementing the waste management hierarchy included the acquisition of waste separation infrastructure, increasing human resource capacity, acquiring funding, improving competence and skills of educators and increasing awareness of learners. The main challenges identified with regards to implementing the waste management hierarchy at secondary schools included administrative issues, lack of infrastructure, learner attitudes/behaviour and time constraints.

Keywords: perceptions, opportunities, challenges, waste management hierarchy, secondary schools

ABBREVIATIONS AND ACRONYMS

AU	African Union
CSIR	Council for Scientific and Industrial Research
DBE	Department of Basic Education
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DEFF[1]	Department of Environment Forestry and Fisheries
DFFE	Department of Forestry Fisheries and Environment
EMIS	Environmental Management Inspector
EPR	Extended Producer Responsibility
EU	European Union
IDP	Integrated Development Plan
IWMP	Integrated Waste Management Plan
MRF	Material Recovery Facility
NCS-CAPS Statement	National Curriculum Statement-Curricula and Assessment Policy
NEMWA	National Waste Management Act 59 of 2008
NWMS	National Waste Management Strategy
PPP	Polluter Pay Principle
RDF	Refuse Derived Fuel
SADC	Southern Africa Development Community

[1] Now the Department of Forestry, Fisheries and Environment (DFFE)

SDG	Sustainable Development Goal
SMME	Small, Micro and Medium Enterprises
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WFD	Waste Directive Framework

KEY DEFINITIONS

Secondary schools

Secondary education in South Africa is six years in duration (grades 7 to 12), and is divided into two phases, lower and upper secondary school (Department of Basic Education, 2022).

Separation of waste

It is separating waste streams or categorisation for separate collection (DEFF, 2020:15)

Support staff

School workers responsible for cleaning and up-keep of school environment (Department of Basic Education, 2022)

Waste

Means any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be reused, recycled or recovered and includes all wastes as defined in Schedule 3 of the Act and includes residue deposits and residue stockpiles (Condensed version of NEMWA definition, South Africa, 2008).

Waste as a resource

Refers to beneficiating waste through reuse, recycling, treatment and recovery to reduce the amount and toxicity of waste disposed of (DEFF, 2020: 22).

Waste management hierarchy

It is a systematic and holistic approach to waste management during the waste life cycle, which addresses waste reduction, and safe disposal as a last option (DEA, 2011: 6; DEA, 2012: 279).

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CHAPTER 1 INTRODUCTION

1.1 Introduction

This chapter provides the background of the research, which focuses on the perceptions of teachers on the implementation of the waste management hierarchy within secondary schools. The chapter further defines the problem statement, aims, objectives, as well as assumptions and limitations. The structure and outline of the research is given and a conclusion.

1.2 Background

Waste management issues are a critical environmental problem that affects both developed and developing countries, globally. The generation of waste has increased across the world, and the situation is exacerbated by a lack of proper waste management practices (Debrah *et al*., 2021). Africa, being a developing continent, is lagging in the proper management of waste. Rapid population growth, urbanisation, increased economic development, changing consumption habits, failure of institutional authorities and insufficient governance, budgetary constraints and insufficient knowledge, skills, and capacity, are some of the waste management challenges highlighted by the African Waste Management Outlook (UNEP, 2018).

The African Waste Management Outlook specifically highlights the challenges that a lack of knowledge about waste management and related opportunities play towards achieving responsible waste management (UNEP, 2018: 23). Furthermore, the report emphasises the importance of training and education as part of the future actions to be taken to address waste management challenges in Africa (UNEP, 2018:97). Similarly, South Africa's National Waste Management Strategy (NWMS) of 2011 (Goal 4) aimed to ensure *that "people are aware of the impact of waste on their health and well-being"* (DEA, 2011: 17). The NWMS seeks to create awareness of waste management issues and to add practical waste projects to basic education curricula. The revised 2020 NWMS (DEFF, 2020), likewise, acknowledges that *"a lack of waste management awareness is a major factor which impede proper waste management in South Africa"* (DEFF, 2020:14). The 2020 NWMS highlights the need for behavioural change by communities and individuals to achieve awareness and participation in waste management. The strategy furthermore favours environmental education and awareness campaigns in schools, including waste management practices that promote the waste management hierarchy.

In 2017, South Africa was estimated to have generated 55 million tonnes of waste per year (DEFF, 2020). Although our NWMS are aspirational and aims at diverting waste from landfills, South Africa is still largely disposing of the majority of waste generated to landfill sites. It is argued that

awareness and knowledge of appropriate waste management measures would reduce littering and promote the implementation of the waste management hierarchy (DEA, 2011).

Hasan (2004), asserts that a critical component in any waste management programme is public awareness and participation. It is important that everyone understands the waste management issues as they result from human activities. It is argued that, a person who is informed and environmentally aware will consciously implement responsible waste management practices (such as the waste management hierarchy) (Hasan, 2004).

1.3 Problem statement and rationale for the study

Education plays an important role in creating awareness of waste management problems (Mbalisi & Offor, 2012: 256). As mentioned above, the 2011 and 2020 South African NWMS emphasise the importance of education programmes in creating a waste management awareness in the country. Educational institutions, such as schools and universities play an important role towards achieving waste-related education and awareness. It is important that students are aware of waste management programmes and practice them in their schools.

Research conducted by Kainth (2009), Dytrtova & Nemeje (2018) and Mahbub *et al.* (2019) on waste management in educational institutions, highlight the significant role that school teachers (educators) play towards education and awareness on sustainable waste management practices. According to Karatas (2013: 239) teachers are custodians of education and the “most powerful agent” imparting knowledge on sustainable waste management practices to students.

As mentioned earlier, the South African NWMS recognises the need for promoting education and awareness on waste management in order to implement the waste management hierarchy (DEFF, 2020). Pillar 3 of the strategy, specifically, highlights the role of schools in achieving awareness and community participation towards implementing the waste management hierarchy (DEFF, 2020:38). In the South African context, it is, therefore, important for teachers to be well-equipped with knowledge regarding sustainable waste management to transfer that knowledge to students to increase environmental consciousness and improved waste management practices of students. This research specifically evaluates the importance of awareness and knowledge of school teachers regarding the *waste management hierarchy*.

Although the implementation of the waste management hierarchy in schools has not been widely researched in the South African context, the role that schools and teachers may play in waste related knowledge and practice transfer is recognised (Karatas, 2013; Nxumalo, 1999). Karatas (2013) stresses the importance of schools for a nation’s future socio-economic development, where schools play a crucial role in grooming and shaping the future of students, as these

students spend a significant amount of their young lives in learning institutions. Teachers, therefore, play a pivotal role in in imparting the correct knowledge to students. Nxumalo (1999) asserts that the management of waste in schools would be effective if waste management education was introduced at primary and secondary school levels. The measure would enable students to adopt a positive culture of waste management, but it was observed that schools were generally unaware of sufficient waste management practices (Nxumalo, 1999).

1.4 Research aim and objectives

This research aimed to explore the perception of teachers in the implementation of the waste management hierarchy within secondary schools, by focussing on a case study area, namely Ekurhuleni North in Gauteng.

The research question is, thus, *what are the perceptions of teachers on the implementation of the waste management hierarchy within secondary schools in Ekurhuleni North?*

To answer the research question, the following research objectives were set:

1. Understanding *knowledge on and level of implementation* of the waste management hierarchy within secondary schools.
2. Exploring *opportunities* in the implementation of the waste management hierarchy within secondary schools.
3. Exploring *challenges* in the implementation of the waste management hierarchy within secondary schools.

1.5 Scope of the research

The research focused on exploring the *opportunities* and *challenges* towards implementing the *waste management hierarchy* at *secondary schools*. The research findings were based on the perceptions of *school teachers* at selected secondary schools located in *Ekurhuleni North, Gauteng*. Research respondents included *85 teachers* from *29 secondary schools* in the area.

The research did not include the perceptions of pupils/students on the implementation of the waste management hierarchy. Participants included only school teachers, and no participants under the age of 21 were involved in the research.

Ekurhuleni North has a concentration of independent and public secondary schools in a small geographical area. Both independent and public schools were included in the research.

The research was conducted between June and August 2022.

1.6 Assumptions and limitations

The study was be based on the following assumptions:

1. All participants were qualified secondary school teachers.

Limitations:

1. Responses are representative of secondary school teachers in Ekurhuleni North, Gauteng. No other areas in Gauteng nor any other provinces are represented.
2. The research focussed on secondary school teachers and did not include the perceptions of any teachers from primary schools or tertiary education institutions.
3. The research was limited to the perceptions of teachers and did not include perceptions of any pupils or any other role players.

Although the research was conducted within a secondary school context within a specific spatial area in South Africa, these results may be equally applicable to schools located elsewhere in South Africa.

1.7 Potential contribution of the research

The research adds to body of knowledge to earlier research done by Nxumalo (1999) on "*Waste management through recycling and composting: A case study of some schools in Greater Edendale"*. The research aimed at determining the perceptions of school teachers on the opportunities and challenges regarding the implementation of the waste management hierarchy within secondary schools.

The South African National Waste Management Strategy (DEFF, 2020) acknowledges the important role that schools play towards achieving awareness and knowledge on sustainable waste management practices, the research could contribute to towards successfully implementing the waste management hierarchy at South African schools.

1.8 Structure and outline of the dissertation

The dissertation comprises of five chapters. The first chapter gives a brief introduction to the research background of the research problem statement in respect to the research question, aim, objectives and scope of the research, assumptions and limitations and potential contribution of the research Chapter two provides the literature review chapter with an extended background on the research topic to provide contextual information for overall understanding of the components of the research. Chapter three focuses on the methodology followed to conduct the research.

Chapter four provides the results and discussion research findings, in relation to the research aim and objectives. Finally, chapter five provides the conclusions and recommendations of the research.

1.9 Chapter summary

This chapter provided the background, problem statement and rationale for the research, as well as the aims and objectives. Furthermore, the chapter outlined the scope of the research followed by the limitations and assumptions and the potential contribution to body of knowledge. The following chapter, Chapter 2, provides the literature review.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

Chapter 1 provided the background of the research, with aims and objectives of the study. Chapter 2 attempts to link the aim and objectives of the study with available literature. The literature review explores global, African and South African waste management issues in relation to the aim of the research, i.e. *implementation of the waste management hierarchy and the perceptions of secondary school teachers.* The chapter will give further detail of the waste management hierarchy practice in South Africa and its implementation using different national regulation instruments. It also reviewed the importance of education in the implementation of the waste hierarchy in secondary schools.

The aim of the literature review was to provide context to the research, and provide the basis for discussion and comparison of the results of this research to what other authors have found.

The literature review made use of international and local publications. Google Scholar, Scopus and the NWU Library repository were the main platforms used to search for relevant literature using the following keywords “education”, “knowledge”, “waste hierarchy”, “waste management hierarchy”, “waste management in schools”, “schools”, “secondary schools” and/or “separation of waste in schools” in different combinations.

Research conducted by Hasan (2004), Kainth (2009), Karatas (2013) and Mahbub *et al*. (2018) and Dytrtova & Nemeje (2018) provided literature on waste management aspects researched within educational institutions. While dissertations by Armien-Ally (2013) and Nxumalo (1999) provided a comparative South African context on the implementation of waste management hierarchy in schools.

2.2 Global waste management issues

The increase in waste generation across the world complicates proper waste management activities (Debrah *et al*., 2021). Uncontrolled waste disposal can affect public health and the environment. Waste collection and management varies from one country to another. Debrah *et al*. (2021) highlight that less than 50% of waste generated is collected in low-income countries, 58% is collected in middle-income countries and more than 90% percentage is collected in developed, high-income countries. Research has shown that the developing countries face an up-hill task in dealing with waste management issues (UNEP, 2018). Waste generation has increased in many parts of the world as a result of rapid population growth in urban areas and increased consumption in developing countries. Proper waste management is seen as a major

challenge, as many authorities or governments are incapacitated to deal with increased volume of waste, especially in developing countries (Debrah *et al.*, 2021).

The waste management hierarchy has received increased focus from the 1980s, with a priority in waste reduction, recycling and reuse of material over treatment and disposal (Van Ewijk & Stegemann, 2016). The Waste Framework Directive (WFD) by the European Union elaborated on the importance of waste prevention, preparation for reuse, recycling, recovery and landfill on a preferential scale in the early 1990s (Van Ewjk & Stegemann, 2016). The waste hierarchy is viewed as a priority order of the best overall environmental option in waste legislation and policy (Gertsakis & Lewis, 2003).

2.2.1 African Waste Management issues

In 2012, Africa generated approximately 125 million tonnes of waste and only 55% was collected, with uncollected waste being illegally dumped or burned (UNEP, 2011). Waste generation in Africa is expected to increase to 244 million tonnes per year by 2025 (Debrah *et al.*, 2021: 3).

In many African countries, especially in the SADC region, initiatives and plans have been put in place to address waste management issues, however, many countries do not have the capacity and financial resources to implement sound waste management measures (Karani & Jewasikiewitz, 2007). Many municipalities in African countries are constrained by capital, human capacity and institutional abilities contributing to large service backlogs (Karani & Jewasikiewitz, 2007). Although countries in the SADC region have developed their own waste management plans, there is a tendency to disregard aspects such as waste minimisation, reuse, recycling and treatment, which forms the basis of waste management hierarchy (Karani & Jewasikiewitz, 2007).

One of the challenges of waste management in Africa is the provision of waste services in informal settlements, which house about 56% of urban populations in Sub-Saharan Africa (UNEP, 2011). Most countries do not have plans for these settlements and most of the settlements are not accessible to waste management services vehicles as there are no proper roads. Another problem faced is the legal framework for waste management which is fragmented and where legislation is in place, there is no translation into a practical action plan, and this has been noted in South Africa (UNEP, 2011). With weak legislation and no enforcement plans, many African countries fail to provide waste management services to meet the needs of its citizens.

The African Union (AU) has set a standard of 50% of waste generated to be recycled by 2023, yet, waste management remains an environmental challenge for many African countries (UNEP, 2018). The need for the implementation of appropriate waste management measures (for example source separation of waste, education and awareness) is recognised, with the

implementation of the waste management hierarchy being at the heart of achieving responsible waste management (UNEP, 2011).

For Africa to be successful in its waste management endeavours, it needs governments which would create an enabling legal framework for sustainable solid waste management. Waste management needs to be assessed in terms of organisational structure, by-laws and waste collection systems which vary between countries and municipalities within the same country (UNEP, 2011; CSIR, 2011). African governments must invest in waste management infrastructure and projects which are economically viable for sustainability (UNEP, 2011). The fragmentation in legislation must be addressed and enforcement of regulations be prioritised. Finally, the role of education, awareness and capacity building towards improving waste management and implementing the waste management hierarchy are recognised (UNEP, 2018).

2.2.2 Waste management issues in South Africa

Prior to the National Environmental Management Waste Act (59 of 2008) (NEMWA) coming into effect in 2009, waste management in South Africa was managed by different pieces of legislation that were governed by different government departments, which were fragmented in outlook, leading to gaps and poor waste management policies. The promulgation of the NEMWA in 2009, led to the consolidation of waste management practices, with the ultimate aim to reduce pollution and to implement the waste management hierarchy (amongst others) (DEA, 2011).

In 2011, the then Department of Environmental Affairs (DEA) developed the National Waste Management Strategy (NWMS) to meet the objectives of the NEMWA and set goals and objectives to address waste management challenges and issues in the country (Van Jaarsveldt, 2016).

Although government has developed an extensive legal framework to address South Africa's waste management issues, the country is still facing various waste management woes emanating from "economic development, growing population, increasing rates of urbanisation, deteriorating infrastructure, and lack of compliance and enforcement" (DEFF, 2019: 278). Other areas of concern include inadequate waste management infrastructure and funding, insufficient capacity, and low awareness and knowledge of waste management requirements.

The next sections provide an overview of the waste management hierarchy (Section 2.3) and a brief framework towards addressing waste management in South Africa, mainly focusing on the implementation of the waste management hierarchy (Section 2.4).

2.3 The waste management hierarchy

The waste management hierarchy is the ordering of waste management options according to their possible environmental consequences (DEA, 2011, Van Ewijk & Stegemann, 2016, DEFF, 2020) (Figure 2-1).

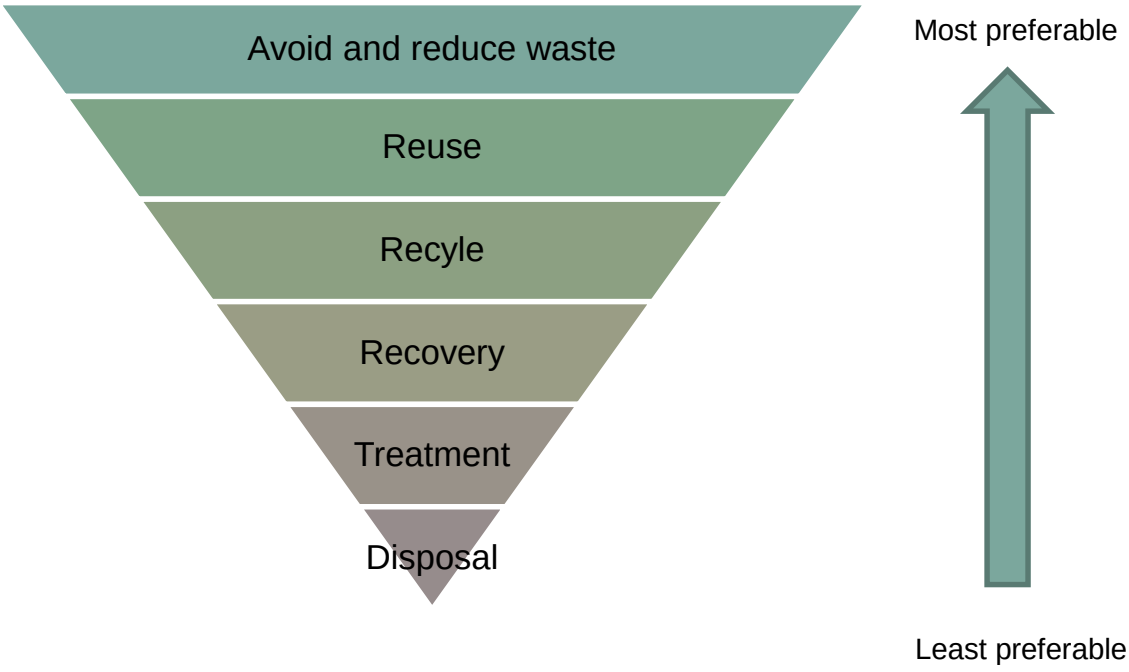


Figure 2-1: The waste management hierarchy (adapted from the National Waste Management Strategy, 2011)

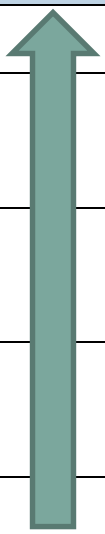
The waste management hierarchy advocates the preferred avoidance and reduction, reuse, recycling, recovery and treatment of waste, as more favourable options to disposal (Figure 2-1). The waste management hierarchy started to surface in the early 1980s when the environmental movement (especially in the developed world) caused a paradigm shift where waste was not regarded as being unwanted and without value, and its potential use as a "resource" was acknowledged (Gertsakis & Lewis, 2003: 7).

In the European Union (EU), legislation and environmental monitoring tools were passed, which sought to move waste up the hierarchy (Pasvenskiene, 2011). The production of waste by member states of the EU was viewed as being unsustainable and that member states must generate a co-ordinated effort and collaboration with the international community to reduce waste generation (Pasvenskiene, 2011). Australia also followed suit, through the Victorian Environmental Protection Act, where waste was to be managed in order of preference: avoidance,

reuse, recycling, and recovery of energy, treatment, containment and disposal (Gertsakis & Lewis, 2003). The waste hierarchical practices that recommended a key principle of waste management are shown in Table 2-1.

Table 2-1: Waste hierarchical practices recommended in waste management

Goal	Attribute	Outcomes
Reduce	Preventative	Most desirable
Reuse	Predominantly ameliorative Partly preventative	
Recycle	Predominantly ameliorative Partly preventative	
Treatment	Predominantly assimilative Partially ameliorative	
Disposal	Assimilative	Least desirable



The aim of the waste hierarchy was to reduce the least desirable option of waste disposal (Pasvenskiene, 2011) to reduce the negative impacts of waste on the environment.

2.4 Brief overview of the framework for waste management in South Africa: Towards implementing the waste management hierarchy

The Constitution of South Africa (Act 108 of 1996) established the Bill of Rights, which in Section 24 states that *everyone has the right to an environment that is not harmful to their health and well-being, and to have their Environmental Right protected through reasonable legislative and other measures* (South Africa, 1996). The National Environmental Management Act (107 of 1998) (NEMA) is South Africa's framework environmental law providing for environmental protection and provides principles for environmental management, such as "pollution prevention", "polluter pays", "duty of care", "integrated and holistic approach)", and advocates the waste management hierarchy (South Africa, 1998).

Before enactment of the NEMWA, the *White Paper on Pollution and Waste Management* introduced the waste management hierarchy as part of South African waste management policy (DEAT, 2000). Since coming into effect in 2009, the NEMWA specifically deals with waste management in the country. The Act provides for the development of a National Waste Management Strategy (NWMS) and outlines several requirements aimed at delivering waste

management services, preventing pollution and illegal dumping and dealing with waste in a responsible manner. The importance of moving waste up the waste hierarchy is recognised in the objects of the Act, as well as Sections 16 and 17 of NEMWA (South Africa, 2009).

The National Waste Management Strategy (NWMS) aims to direct waste management efforts towards achieving specific goals (2011 NWMS) or pillars (2020 NWMS). The NWMS was promulgated in 2011 and revised in 2020 to make it relevant to changes in the waste industry and to be relevant to current situation (DEFF, 2020). Two aspects which are important to consider in this research is the fact that the NWMS highlights both the importance of the "waste management hierarchy" as well as the role of "knowledge" and "awareness" of waste. The strategy also acknowledges the roles of schools towards improving waste management, as explained below.

South Africa's National Waste Management Strategy (NWMS) of 2011 (Goal 4) aimed to ensure *that "people are aware of the impact of waste on their health and well-being"* (DEA, 2011). The NWMS seeks to create awareness of waste management issues and to add practical waste projects to basic education curricular. The revised 2020 NWMS (DEFF, 2020), likewise, acknowledges that *"a lack of waste management awareness is a major factor which impede proper waste management in South Africa"* (DEFF, 2020:14). The 2020 NWMS highlights the need for behavioural change by communities and individuals to achieve awareness and participation in waste management.

The NWMS of 2020 incorporates the Sustainable Development Goals (SDGs) by advocating for sustainable production and consumption patterns by implementing enterprises that reduce waste and promote recycling, reuse and implementing public awareness initiatives (DEFF, 2020: 17). The strategy furthermore favours environmental education and awareness campaigns in schools, including waste management practices which promote waste hierarchy (Zhakatha *et al.,* 2016).

It should, however, be noted that many waste management activities related to the waste management hierarchy requires the application for a waste management licence. GNR. 921 of November 2013 (as amended), the list of activities requiring a waste management licence, lists a number of activities (i.e. recycling of waste, treatment of waste, etc.) where the applicant needs to apply for authorisation before conducting the activity (South Africa, 2013). This requirement to apply for a waste management licence may been seen as a means of positively regulating the reuse, recycling, recovery and treatment of waste, however, it may also be regarded as an obstacle towards pursuing activities towards implementing the waste management hierarchy, because of the cost and time that it takes to apply for authorisation (Godfrey *et al*., 2013).

Moreover, the *Waste Information Regulations* (GNR. 625 of August 2012) requires reporting on waste information related to activities involving the recovery, recycling and treatment of waste (South Africa, 2012). While the aim of these regulations is to improve reporting on the quantities and types of waste reused, recycled, recovered and treated in South Africa, the South African Waste Information System is still largely under-utilised with many users not reporting their waste information (Godfrey *et al*., 2012).

Furthermore, in an attempt to enhance the implementation of the waste hierarchy, the South African government has promulgated regulations such as the *Waste Exclusion Regulations* (GNR. 715 of July 2018) (South Africa, 2018) and the recently promulgated series of *Extended Producer Responsibility (EPR) Regulations* (published in GNR R.1184, R.1185, R.1186 and R.1187 of 5 November 2020, as amended) (South Africa, 2020). The ultimate goal of the EPR regulations is to enhance the implementation of the waste management hierarchy, towards waste being viewed as a resource, with less disposal of waste to landfill (Muzenda, 2014).

Although South African legal framework for waste management aims to implement the waste management hierarchy (Zhakatha *et al.,* 2016), there is still a serious challenge in the implementation of waste management strategies in the country (Mosidi, 2011). There seems to be a gap and lag between the development of legislation and its implementation.

2.5 Waste management hierarchy implementation in South Africa

South Africa has been working hard to try and reduce the amount of waste sent to landfills. In 2011 South Africa sent about 90% of its general waste to landfills (DEA, 2012). The figure indicates that the country is not practicing the waste management hierarchy concept. South Africa advocates for the practice of waste management hierarchy, but with 90% of waste going to landfills show the insurmountable task ahead of its waste management plans. The evidence shows that reuse, recovery and recycling are still at their infancy (DST, 2014). South Africa has continued to landfill because of lower costs compared to alternatives of disposing waste.

It is imperative that South Africa increases its rate of recycling, reuse and recovery of waste material. The 2011 NWMS strategy focussed on reaching a target of 25% of recyclables to be diverted from landfill sites for reuse or recovery by 2015 (DEA, 2011:35). Recycling and recovery were to be achieved by separation at source programmes of waste material. The revised 2020 NWMS focussed on making South Africa transform to a “circular economy” through recycling and reusing waste material. The new NWMS aimed at improving the 2017 South Africa’s waste statistics, which indicated that only 11% of waste was being diverted from the landfills (DEFF,

2020:11). The State of Waste Report (SoWR) 2018, showed an improvement in recycling and recovery of certain waste types. The results are shown in Table 2-2.

Table 2-2: Waste recycled versus waste disposal (Source: State of Waste Report. DEA, 2018)

Waste type	Recycling/ recovered	Disposal
Paper	58%	42%
Plastic	43.7%	56, 3%
Glass	71,2%	28.8 %
Metals	80 %	20%
Organic Waste	49,2%	50.8%

The results show that South Africa has to implement more strategies which reduce waste to landfills. Waste types like paper, plastic and organic waste have high figures which can be reduced if efficient recycling recovery methods are implemented effectively. The SoWR (2018) indicated that of 55.6 million tonnes of waste generated in South Africa in 2017, estimates that 43.5% of the waste was recycled (DEA, 2018). The 2020 NWMS outcome, based on strategic Pillar 1, has specific targets which are intended to be met by South Africa in years to come. Outcome 1 of Pillar 1 wants 40% of waste to be diverted from landfills within 5 years, 55% within 10 years and about 70% within 15 years.

2.6 Opportunities and challenges for the implementing the waste management hierarchy in South Africa

The sections below focus on the opportunities and challenges which South Africa faces in the implementation of waste management hierarchy. The first part looks at what South Africa can learn and adopt from other countries and local initiated solutions for a successful waste management hierarchy. The second part focuses on challenges which hinder a successful implementation of a waste management hierarchy in South Africa.

2.6.1 Opportunities for implementing the waste management hierarchy

The next sub-sections outline opportunities for implementing the waste management hierarchy.

2.6.1.1 New waste technologies

New waste technologies are necessary to reach sufficient technical capacity and human capital in waste management field which would enable an efficient waste management. South Africa must have new waste treatment options which would ultimately reduce the amount of waste going to the landfills (DEFF, 2019). The new technologies would lower South Africa's high rate of 90% waste destined to landfills (DEFF, 2019). South Africa would need to develop more of recycling facilities and transfer stations. New technologies and innovations in waste would allow efficient waste collection and disposal services. The new technologies and innovations in waste management, allows the transformation and the creation of a secondary economy (DEFF, 2020: 27). The new technologies would allow composting and converting waste to energy. Plastic recycling rates must be increased through introduction of materials recovery facilities and petroleum plants. Pyrolysis plants can be used to produce fuels and other related products in the energy recovery process.

2.6.1.2 Job creation

Waste collected and recycled has the potential of creating jobs of South Africa. The provision of waste management services leads to the creation of both skilled and unskilled jobs. Waste management is a labour-intensive industry through recycling activities which has potential of creating lot of employment opportunities (DEFF, 2019). Employment opportunities will be in the local municipalities and the private sector to self-waste pickers. South Africa is lacking formal systems for separation at source of recyclables, the waste pickers have the opportunity to take part and make a living out of separation at source (DEFF, 2020).

Job creation would be accelerated by the support and development of small to medium enterprises in the waste management value chain (DEFF, 2020: 31). Waste management encourages entrepreneurship which would stimulate job creation and skills development.

2.6.1.3 Waste to energy

South Africa can convert waste recovered to fuel, the recovery of energy from waste could reduce the need to generate energy using fossil fuels which contribute to negative effects on the environment which accelerate global warming (DST, 2014). Waste to energy could promote energy security in South Africa. The reuse of resources reduces the loss of energy. Recovery of landfill gas would enable the generation of electricity and the gas can be treated and upgraded. Waste to energy schemes could be implemented at municipal level, where landfill gas would be extracted to produce electricity and sold to local communities. Energy recovery schemes could be used in centres to generate carbon credits and potential resources (DEFF, 2019: 303).

Opportunities for waste to energy could be investigated more from thermal treatment processes. South Africa can engage in pyrolysis and gasification projects, which can produce secondary fuels which could be used to provide solid coke residues, which might be used as a coal substitute (Nkosi *et al*., 2013).

2.6.1.4 Reduction to costs of landfilling

South Africa must aim to reduce waste going to the landfills, as this would reduce the costs of landfilling. The diversion of waste from landfills will allow landfills to have an expanded life span and would prolong decommission of landfills which is a costly exercise (DEFF, 2020). A reduction in cost of landfilling could be met by promoting separation at source and establishing Material Recovery Facilities (MRFs) and Refuse Derived Fuels (RDF) plants, increased recycling and beneficiation of industrial waste (DEFF, 2020).

One of the opportunities which arise when organic waste is diverted from landfills would be composting and recovery of energy. An opportunity which can be exploited is to develop and implement the production of biogas through anaerobic bio-digestion of organic waste treating sewage and organic domestic waste (DEFF, 2020). One of the benefits of reducing landfilling is reducing wind dispersing debris, rodent, and bird infestation and pollution of ground and surface water and also reduced foul odour (Nkosi *et al*., 2013). It is projected that a reduction in methane emissions from landfills would benefit the environment and of offer local authorities the prospects for the generation of revenue and business opportunities (Karani & Jewasikiewitz, 2005). Alternatives to landfilling would maximise waste diverted from landfills to promote a “green economy” (DST, 2014: 2). A reduction in landfilling would promote the re-introduction of resources back into the economy.

2.6.1.5 Decreasing the reliance on natural resources

The government of South Africa aims at preventing the exploitation of new resources which has a negative impact on the environment. One of the outcomes under the NWMS aims at minimising the consumption of natural resources (DEFF, 2020). The NWMS emphasises the stimulation of a secondary resource economy through recycling and reuse of materials from waste (DEFF, 2020). It is important that South Africa exploits the full potential value of waste and put it into best use. Should South Africa reduce the reliance on natural resource, it would preserve the countries natural resources and promote a sustainable development leading to a “green economy”. Preserving natural resources would promote biodiversity.

Recycling reduces the reliance on natural resources as it ensures a secure supply of essential resources and reduce the exploitation of virgin materials (DST, 2014: 25). A waste management

hierarchy would transform waste to be a valuable resource and ensure secure supplies of critical resources (DST, 2014). Decreasing the reliance on natural resources would reduce resource extraction and waste disposal when there is recycling and reuse of material (DEFF, 2020). The NWMS aims at encouraging the composting of organic domestic waste where there is a stimulation of economic growth in low-income communities (DEFF, 2020).

2.6.1.6 Incorporating the informal waste sector

South Africa does not have a formal recycling programme, in an environment where recyclers play an important role in saving resources. The 2020 NWMS aims at incorporating the informal waste sector, with special consideration to support women and youths into the circular economy. The NWMS desire the economic empowering of women, youths and people with disabilities, by training and providing skills to the groups (DEFF, 2020). The revised NWMS seeks to incorporate schools in the cleaning up of the environment by recycling of waste and correct disposal. It is important that the informal waste sector must be incorporated and assimilated into the main waste stream activities of the council authorities (DEFF, 2020).

The integration of the informal waste pickers in the formal waste management would help with the separation at source. The separated waste would be diverted from landfills and channelled to centres of recycling to support their businesses (DEFF, 2020). The picking of waste in the landfills could be reduced by collecting waste before it reaches landfills. It is thus important for the waste pickers to be incorporated into the municipal collection services to stimulate recovery rates of recyclables. Municipalities must be working towards the strengthening and expanding the role of waste pickers (DEFF, 2020). The buy-back centres have tried to formalise the work and efforts of the waste pickers. The formalisation of the waste pickers would give dignity and protection to the informal waste pickers.

As outlined in Section 2.4 of this dissertation, South Africa has an enabling legal framework for the implementation of the waste management hierarchy. South Africa promotes a circular economy towards moving waste up the waste management hierarchy by focusing on increasing recycling rates, better waste prevention, reuse and reducing amount of waste to landfills (DEA, 2014). South Africa has an attractive market for the introduction of waste technologies, which would reduce waste to landfills and transform the economy from being linear to circular (DEA, 2014). This economic transformation would create notable economic and social opportunities. Moving waste up the hierarchy gives South Africa an opportunity to acquire new technological innovation (DEA, 2014).

Reflecting on the current actual implementation of the waste management hierarchy in the country (Section 2.5), much room for improvement still exists in implementing waste reduction, reuse, recycling and recovery measures in the country.

South Africa must learn and take advantages of countries like China, which have a strong recycling sector, by learning from them or sending waste resources diverted from landfills to countries with established waste recycling facilities (DEA, 2014). The diversion of waste away from landfilling towards recycling and recovery creates local and global waste economies. South Africa's waste sector has the potential to contribute towards the country's gross national product (DEA, 2014). South Africa has a problem of persistent electricity blackouts, this has stimulated interest in alternative sources of energy, including waste to energy. The waste sector is identified as an emerging economic sector with the opportunity to create new jobs (DEA, 2014). The strategy would reduce unemployment in the country and provide opportunities for the unskilled citizens. Moving waste up the ladder promotes the components of sustainable development, which are social, economic and environmental.

In the waste management hierarchy, certain waste streams are recognised for their secondary resource potential and are diverted from landfills into materials and energy recovery (DEA, 2014). South Africa's waste sector is viewed as a major sector for sustainable development with opportunities for transforming the economy to a secular one that targets reduction of waste to landfills (Karani & Jewasikiewitz, 2007). Karani & Jewasikiewitz (2007: 173-174) further assert that the landfills generate a significant amount of methane gas which enters the atmosphere. Methane can be harnessed and used as a source of energy in South Africa, where ESKOM is failing to adequately provide electricity on regular basis. If methane could be harnessed, the municipalities can get income from the sale of the gas and possibly get potential investment. The opportunities would enable municipalities to reduce methane as a hazardous gas and generate income for the local authority.

2.6.2 Challenges to implementing the waste management hierarchy

South Africa is faced with many challenges in the implementation of the waste hierarchy. South Africa aims at reducing material going to the landfills. The country has come with numerous strategies to divert waste material going to the landfills, but this has been met with lot of challenges.

2.6.2.1 Unsuitability of technologies in South Africa

Although South Africa has made all efforts to reach a sustainable waste management programme, there are serious challenges linked to the unsuitability of technology used in the waste sector.

The problem of lack of relevant technology has resulted in the failure to adhere to stated objectives of the NWMS. South Africa does not have the design of products and packaging that reduce waste or encourage reuse, repair and preparation for recycling (DEFF, 2020). South Africa must design and develop technologies around non-landfills.

South Africa much change technologies used in the collection of waste, as it was not designed tom separate waste at source, for example recyclables which need colour-coded bins to separate waste (DEFF, 2020).

2.6.2.2 Insufficient adequate waste materials

Insufficient adequate waste material is a serious constraint to the implementation of the waste hierarchy. Certain recyclables are not enough for the entrepreneur to make a viable business of waste recycling (DEFF, 2020). The constraints on the economies of scale to reach commercial volumes of recyclables only makes landfilling the only viable option in the temporary (DEFF, 2020).

2.6.2.3 Lack of financial resources

Capital is an important component in the implementation of the waste hierarchy. Many municipalities in South Africa fail to prioritise the waste sector in the allocation of budget funds. The waste sector suffers because the IDPs (Integrated Development Plans) do not integrate the waste sector in their annual budget allocation (DEFF, 2020). Many metros and municipalities do not have an adequate budget to implement the waste management hierarchy programme. It is common for municipalities to just collect and dispose waste to landfills with no implementation of an integrated waste management programme to promote the waste hierarchy (DEFF, 2020). Many local authorities and municipalities face a serious challenge of financial constraints which hamper the implementation of the waste hierarchy. Alternative waste treatment is more expensive than landfilling (DST, 2017). Many of South Africa's local municipalities are in financial dire needs, it becomes difficult for these municipalities to buy specialised vehicles or equipment to handle waste. Most municipalities run of financial deficit waste management services (Mannie & Pretorius, 2014).

2.6.2.4 Limited infrastructure

One of the major challenges which South Africa faces in the implementation of the waste hierarchy is the absence of recycling infrastructure. Recycling infrastructure enables separation of waste at source and diversion of waste (DEFF, 2019). The waste could be diverted to material recovery facilities and buy-back facilities, leading to less waste going to landfills.

South Africa has not updated its waste infrastructure since independence to handle the increased waste generation (DEFF, 2019). South Africa has limited capital investment in the waste sector leading to increased challenges in maintaining the ailing infrastructure (DEFF, 2019). South Africa has few waste treatment options to handle waste compared to landfills. The available options are expensive and reduce their usage. The challenges of infrastructure is also shown by few adequate and compliant landfills, this impedes the safe disposal of waste streams (DEFF, 2019).

The low levels of separation at source caused by limited infrastructure result in most waste ending up in landfills. South Africa has limited infrastructure to facilitate the full implementation of the waste hierarchy. More challenges are noted in lack of access to transport equipment or premises at which to sort and store recyclables (Godfrey & Oelofse, 2017). South Africa's by-laws are inadequate and the enforcement is none existent, due to the lack of resources and poor infrastructure, especially in the informal settlements, which house majority of urban poor dwellers (Mannie & Pretorius, 2014). Mixing of waste is a challenge in South Africa as there are no separation facilities or formal waste recycling systems.

Although the regulations in South Africa emphasise enforcement and compliance, there is an enormous challenge in the implementation of waste management hierarchy in many sectors of the economy (DEA, 2014). South Africa has a challenge of regarding waste not as a resource that can offer economic opportunities, people fail to adopt best practices in the management of waste (Pholose, 2019).

2.6.2.5 Lack of local implementation of national legislation

South Africa has elaborated policies on waste hierarchy, but the implementation of the regulations remains a serious challenge (DEFF, 2020). The management of waste in South Africa is grounded on the concept of the waste management hierarchy. The management of waste in municipalities has not been in line with the hierarchical approach. The publication of the NEMWA and the NWMS all speak of the implementation of the waste management through the hierarchical approach. The thrust of the legislation is to reduce waste going to landfills. The challenge being met is that local authorities are incapacitated to deal with increased volume of waste generated in their jurisdictions.

The local municipalities have failed to implement the national legislative waste policies. The evidence of lack cooperative governance is the increasing levels of illegal dumping of waste across South Africa, which is a contravention of Section 24 of the Constitution (Zhakata *et al*., 2016). Although the local government and municipalities play a primary role in the articulation of

national waste legislation between the public and the government, there are no proper structures to connect the two (Zhakata *et al*., 2016).

2.6.2.6 Insufficient capacity, knowledge and skills

One of the major problems faced by South Africa in the implementation of the waste hierarchy is that local and provincial authorities have little control over the generation of waste and limited capacity to achieve source reduction (Gertsakis & Lewis, 2003). South Africa's waste management strategy hits a snag because of lack of sufficient technical capacity in the waste management field (DEFF, 2019). South Africa has a challenge of the absence of qualified administrators, poor policy support of prevention at the top level, lack of programmes and methods to aim for the top priority of prevention and failure by politicians to commit themselves to the programme of waste hierarchy (Debrah *et al*, 2021; Van Ewijk & Stegemann, 2016).

2.6.2.7 Limited compliance and enforcement

The Waste Act has an elaborate legal framework for waste management in South Africa. The statutory instrument is faced with lot of challenges as measures to monitor waste management and to enforce compliance is lacking (DEA, 2011). South Africa has lot of pertinent challenges as a result of limited compliance and enforcement. One of the major challenges is illegal dumping of waste as a result of limited compliance and enforcement (DEFF, 2020).

The NWMS (2020), highlights the failure of government departments to follow legislation which allow an efficient implementation of the waste hierarchy. One of the challenges is lack of implementation, monitoring and reporting of waste management issues (DEFF, 2020). Local government and industries have failed to report correct types of waste streams and volumes, which negates a correct picture on the implementation of the waste hierarchy (DEFF, 2020).

Another challenge faced by the implementation of the waste hierarchy is where there is no compliance at local and provincial levels which generates to illegal dumping. The local councils fail to enforce by- laws to prevent illegal dumping and littering, which is a violation of Section 24 of the Constitution. Outcome 3 of Pillar 3, talks of improving levels of compliance by addressing the problems of littering and illegal dumping and enforcing statutory instruments to combat there problems DEFF, 2020: 39).

Compliance and enforcement are a thorny problem in municipality owned landfills with licensing conditions (DEFF, 2020). Failure of compliance and enforcement in waste management would not produce the desired results for the waste hierarchy. Many activities in in the waste sector are non-compliant citing stringent regulatory system and or legislation (DEFF, 2020). Another

contributing factor to non-compliance is that the enforcement is with different establishment and within different domains of government (DEFF, 2020). Many municipalities do not have the capacity to enforce compliance because of financial constraints. The State of Waste Report, 2018, (SoWR) highlights the level of non-compliance in publicly owned waste facilities, where 26 facilities attained figures range from 0 to 25% for compliance and only 14 facilities had a compliance of 76-100% (DEFF, 2018). The report paints a negative picture of waste management compliance in South Africa. Effective compliance with and enforcement of the Waste Act is obligatory in order to guarantee that the provision of the Act is fulfilled (Zhakata *et al.*, 2016). Goal 8 of the 2011 NWMS seeks to establish effective compliance with and enforcement of the NEM: WA (DEA, 2011) and outlines that the EMIS are to carry out compliance and enforcement duties in line with relevant national and provincial legislation and by-laws (DEA, 2018: 72).

2.7 The importance of awareness, knowledge and education in implementing the waste management hierarchy in South Africa

The right knowledge about the various environmental waste issues confronting our environment is crucial for young people to have at early stages of their lives. Once the right knowledge has been acquired, it would impact on the future generations and the management of the environment. Education plays a pivotal role in improving environmental issues as indicated in the Chapter 36.3 of the Agenda 21 of United Nations Conference on Environmental and Development (UNCED). The United Nations Educational and Cultural Organisation (UNESCO) recommends that environmental education for sustainable development be incorporated into the education and training programmes at all levels (UNDESD, 2006).

As indicated earlier, waste management awareness is important in helping the young generation acquire knowledge about appropriate waste management measures. As discussed in Section 2.4, the National Waste Management Strategy (NWMS) (2020) highlights the importance of education and training towards waste management (DEFF, 2020). Schools are powerful agents of socialisation and teachers are the key factors in the socialisation process, teachers play a pivotal role in schools as they perform educational goals of schools and shape the future of the society (Karatas, 2013).

Knowledge of waste disposal from teachers would raise awareness and encourage the youth change their behaviour to be positive towards waste disposal (Olufemi, 2019). Education - either formal or informal is bound to change people's attitude towards the implementation of waste management hierarchy. Education gives people the capacity to assess and address their waste management concerns (Karatas, 2013: 235), and it stimulates environmental awareness to, ultimately, improve ethical awareness, values and attitudes, skills and behaviour consistent with

sustainable management of the environment and development (Karatas, 2013). A study in China carried out by Liao and Li (2019) found that environmental education can provide knowledge, which influences pupil's attitude towards separation of waste.

Teachers must be at the forefront of pursuing and implementing environmental education. They have the capability to infuse environmental perspectives in the classes and behaviour (Kainth, 2009). Teachers play a crucial role in the waste management hierarchy as they are the primary key to develop skills of knowledge in using education to sustainable environmental behaviour. Debrah *et al.* (2021) assert that teachers provide students with a knowledge base and a comprehensive understanding of visible problems.

2.8 Implementing the waste management hierarchy in South African schools

Waste management in South African schools is still at its infancy. One of the challenges which schools face in waste management is that teachers' lack practical knowledge of waste and understanding of what they teach to pupils (Debrah *et al.*, 2022: 4). Many tertiary institutions which channel out qualified teachers, do not have a regulated curriculum for waste management (Ifegbesan, 2017: 223). It is a challenge because teachers are not equipped with the necessary knowledge and skills in handling waste.

Mahbub *et al.* (2019) recognises that teachers are vital towards extending waste disposal skills, values and solutions to the future generations. Teachers must have adequate awareness knowledge on waste management to significantly influence students now and in the future. Educators must be in the forefront in imparting knowledge of environmental management to students. However, Debrah *et al.,* (2022:11), state that, teachers are found not to be committed to waste management practices in schools. Teachers focus on mainly the teaching and learning and less attention on waste management issues. The negative attitude of teachers to waste management hierarchy and lack of funds to buy adequate technological facilities to manage waste is one of the biggest barriers to implement the waste hierarchy (Debrah *et al.*, 2022). It would be important for teachers to have the right knowledge on waste management hierarchy, as it would transform schools and society as a whole.

Many schools lack financial resources and programmes on how to deal with waste in a school environment. Lack of time to implement a viable waste management hierarchy programme is also a serious challenge.

Another challenge which is faced by schools in the management of waste stems from the problems linked to the local authorities. Many municipalities do not have programmes of waste separation at source which would divert waste streams to material recovery and buy-back centres

(Pholose, 2019). It is a challenge for school environment to separate waste at source as all waste collected is destined to landfills with no attempt to separate for reuse or recycling.

In summary, it is difficult to implement the waste management hierarchy in South African schools, because of financial constraints, limited waste management knowledge of teachers, and a lack of government support for the programmes and lack of infrastructure. The successful implementation of the waste management hierarchy at schools would require a commitment from school administration and positive attitudes from students and teachers, together with the necessary infrastructural and financial support, and skills to implement the necessary measures. Sharing the sentiments of the 2020 NWMS, South Africa must reconsider a comprehensive environmental education plan in schools to facilitate relevant knowledge to students on waste management hierarchy.

2.9 Chapter summary

Chapter 2 provided a review of literature on waste management, the waste management hierarchy, as well as challenges and opportunities towards implementing the waste management hierarchy. The chapter concluded with the importance of education, awareness and training as it relates to the waste management hierarchy, and the important role of schools. Chapter 3 provides an overview of the methodology used to conduct this research.

CHAPTER 3 METHODOLOGY

3.1 Introduction

This chapter describes the research methodology and outlines the research design, data collection techniques and the methodology of data analysis. The chapter also discusses the design of the interview questions and provides a detail of the study area. The research methodology chosen were to ensure the accomplishment of the aim and objectives of the research set out in Chapter 1.

3.2 Research design

Research design involves the drafting and planning of methods (i.e. data collection, data analysis, etc) to address the research objectives, and provides the researcher with a clear research framework. Planning of the research design enables the researcher to identify resources and time needed to conduct the research (Leedy & Ormod, 2013: 92). The research design was informed by the research objectives, and is outlined in Table 3-1.

The research followed a qualitative approach, which sought to explore the perception of teachers in the implementation of the waste management hierarchy within secondary schools. The exploratory nature of the research allowed the researcher to gain insight into the topic, which has not been extensively researched within the South African context. Interviews supported by semi-structured questionnaires were used to gather data (Refer to Section 3.4 and sub-sections). Interviews were used because they allow for gathering in-depth responses on exploratory questions (Leedy & Ormrod, 2013: 281), and have been used in similar research done by other researchers on waste management in secondary school context (i.e. Armien-Ally, 2013; Karatas, 2013; Nxumalo, 1999).

Table 3-1: Research design indicating the research objective, method of data collection and justification

Research objectives	Data collection	Justification
1. Understanding **knowledge on- and level of implementation** of the waste management hierarchy within secondary schools.	Interviews guided by semi-structured questionnaires.	Interviews are frequently used for qualitative data collection, especially in exploratory research (DeJonckheere & Vaughn, 2019). Interviews guided by semi-structured questionnaires are suitable for *"collecting open-ended data to explore participant thoughts, feelings and beliefs on a topic of interest, and delve deeply into personal and sometimes sensitive issues"* (Beatty & Willis, 2007). Unfortunately, conducting interviews is time and resources intensive and method such as survey questionnaires may be more appropriate for larger groups (Beatty & Willis, 2007). The target group of interviewees included secondary school teachers of the Ekurhuleni North Area, Gauteng, and South Africa.
2. Exploring **opportunities** in the implementation of the waste management hierarchy within secondary schools.		
3. Exploring **challenges** in the implementation of the waste management hierarchy within secondary schools.		

3.3 Description of the study area

Ekurhuleni North in Gauteng, South Africa was selected as the case study area to conduct the research. The area was chosen because of the lack of research conducted on the topic in the South Africa, and more specifically, in the study area. The researcher also had a specific interest in the case study area, since he is a teacher working in the Ekurhuleni area. Furthermore, there are many secondary schools located in the area (which are clustered within a 50 – 100 km radius), which made it convenient for conducting the study (in terms of allocation of time and resources). The case study was exploratory aimed to analyse the specific perceptions of teachers on the implementation of the waste management hierarchy within secondary schools of the Ekurhuleni North Area, Gauteng. The study aimed at answering the "what and who "questions of teacher's perception on the implementation of the waste management hierarchy.

Ekurhuleni North is located in the East Rand in the eastern part of Johannesburg, Gauteng, South Africa (Figure 3-1). The district occupies an area of 1,975 square kilometres east of Johannesburg. The Ekurhuleni Metropolitan Municipality is one of the five districts of Gauteng province and one of the eight metropolitan municipalities of South Africa.

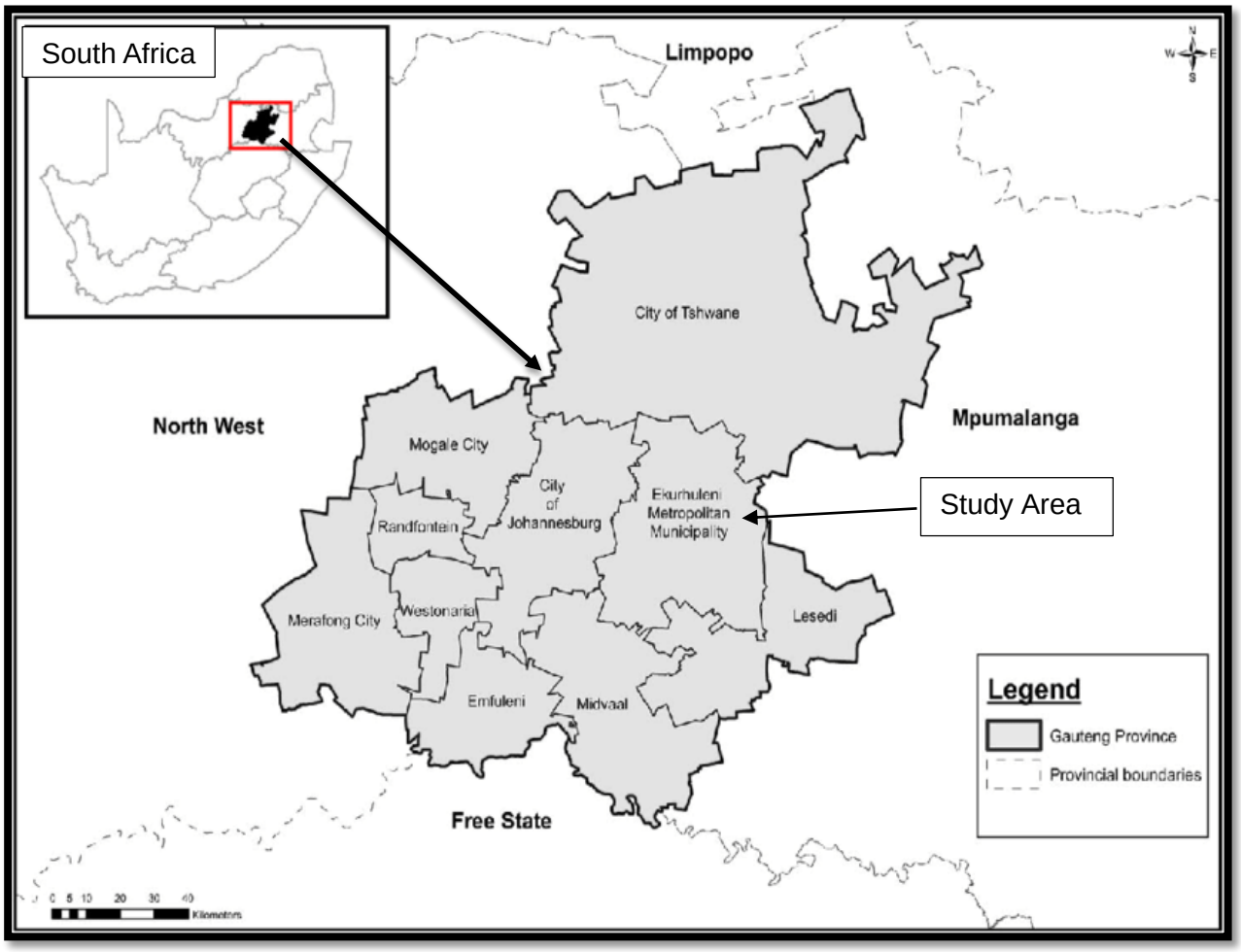


Figure 3-1: Location of the case study area – Ekurhuleni North, Gauteng, South Africa (Source: GSRO-Maps-GIS, 2022)

Ekurhuleni has two school districts - Ekurhuleni North and Ekurhuleni South. This research focussed on Ekurhuleni North secondary schools. The study was conducted in selected secondary schools in Ekurhuleni North district (refer to Table 3-2).

3.4 Data collection

As explained in Section 3.2, a qualitative approach was followed where data was collected by means of interviews, supported by semi-structured questionnaires. Interviews are appropriate for the exploratory nature of the research, as explained in Section 3.2 of this dissertation. Leedy &

Ormrod (2013), point out that semi-structured questionnaires are useful to structure the questions of the researcher and responses of interviewees, while still allowing for open, exploratory discussions.

The sections below provide an outline of the process of developing the interview questionnaire, piloting the questionnaire, sampling interviewees, as well as conducting the interviews.

3.4.1 Description of drafting the interview questionnaire

The researcher was directed by guidance provided by Cohen *et al.* (2007: 357), when drafting the interview questionnaire, which related to:

- The objectives of the interview;
- Depth of the knowledge required; and
- Respondent's background and level of education.

A hard copy interview questionnaire was used to support interviews. The semi-structured questionnaire was developed to include an introduction about the purpose of the interview, with an informed consent section, and three sections.

The introductory section provided interviewees with background on the research, confidentiality arrangements, and their right to withdraw from the interview at any time. The informed consent section required the respondents to sign and acknowledge that the respondent participated voluntarily. The researcher had to make a confirmation that he had explained to the participants in a language and manner that the respondent understood.

Section A of the interview questions aimed at gathering demographic information of the respondents, which included the number of years the respondents had been teaching, their ages, gender, grades and subjects taught. The demographic information was used to indicate the representative nature of the interview respondents. The demographic information was not used for any further analysis, associations or correlations.

Section B of the interview questionnaire focused on the waste management hierarchy implementation in respondents' secondary schools (research objective 1). It sought to gather information on how schools are implementing the waste management hierarchy. The section was also designed to get views and opinions and knowledge of teachers on the implementation of waste management hierarchy in their schools. The questions were sequenced from general to more specific to make the respondent feel at ease (Cohen *et al.*, 2007: 359).

Section C of the questionnaire aimed to identify opportunities (research objective 2) and challenges (research objective 3) towards the implementation of the waste management hierarchy in the respective schools of the respondents. The last question in Section C aimed at identifying mechanisms to address challenges and optimise opportunities towards implementing the waste management hierarchy at the secondary schools. The semi-structured questionnaire is attached to **Appendix 1** of this dissertation.

3.4.2 Description of piloting interview questionnaire

The interview questionnaire was piloted (tested) to refine and make amendments to the questions where necessary (Berg, 2001; Creswell, 2013). Bless *et al.* (2006: 184), define the pilot study as *"a small study conducted prior to a larger piece of research to determine whether the methodology, sampling, instruments and analysis are adequate and appropriate".*

Five participants, which are secondary school teachers working at the school where the researcher is teaching, were requested to participate in a pilot interview. These pilot respondents had a similar background to the actual respondents the researcher targeted as respondents for the research (Zikmund *et al.,* 2013). The researcher conducted interviews with each of the five pilot participants and requested them to respond on any ambiguities or areas, which seemed unnecessary.

After the pilot study, the researcher used the guidance provided by Berg (2001: 80) to refine the questionnaire:

- *Are all of the questions necessary to test the research aim?*
- *Do questions elicit the responses which were expected?*
- *Is the language understood by respondents?*
- *Is there clarity in the questions to the participants?*
- *Does the interviewer guide and stimulate respondents to participate in the study?*

After completion of the pilot study, the interview questions were modified where necessary. The pilot study also provided an indication of how long an interview would last with a respondent. It enabled the researcher to plan ahead in terms of time framework for data collection during the research.

Respondents from the pilot phase were not included in the results of the study.

3.4.3 Sampling procedure

The secondary schools in the Ekurhuleni North case study area were purposively selected, as explained in Section 3.3. The purposive sampling belongs to the group of non-probability sampling techniques and was adopted, where the sample members are selected on the basis of the knowledge or expertise regarding a research subject (Friedman & Shepeard, 2007). The researcher aimed to include a representative sample of schools (with a representative number of teachers from each school) in the research. Samples (instead of full populations) are used to save time, financial and human resources (Kumar, 2019).

Table 3-2 outlines the number of public and semi-independent (private) secondary schools in Ekurhuleni North, also indicating the number of schools selected per circuit, and the number of teachers interviewed per school. A circuit represents the management sub-units of a district with a number of schools administered by the Department of Basic Education (DBE). The sampling process attempted to get sufficient representation of schools and teachers from each of the circuits, for both public and semi-independent schools.

Table 3-2: Secondary schools included in the research study, with number of schools sampled and number of teachers interviewed per school

Circuits	Public schools			Semi-independent schools		
	Total number of secondary schools per circuit	Number of schools sampled	Number of teachers interviewed	Total number of secondary schools per circuit	Number of schools sampled	Number of teachers interviewed
1	12	9	24	4	1	2
2	12	4	11	4	2	9
3	12	6	15	8	5	17
4	10	1	2	1	1	5
Total	**46**	**20**	**52**	**17**	**9**	**33**

A total of 29 secondary schools (20 public, 9 semi-independent) were purposively selected for inclusion in the research, based on the schools meeting the selection criteria and their willingness to participate in the research. Although all of the secondary schools in each circuit of Ekurhuleni North were invited to participate in the interviews (to get the largest and most representative sample possible), not all of the schools were willing to participate in the research. In circuit 4, for instance, only one of the public schools were willing to participate in the research. The 29 participating secondary schools represented an acceptable sample size of 63% of the 46 schools located in Ekurhuleni North.

From the 29 secondary schools, a total of 85 teachers (52 public, 33 semi-independent) agreed to participate in the research. The 85 teachers included in this research were all qualified secondary school teachers. The interviewees were invited through the head or principal of each school visited. The head of the school informed the teachers of the presence of the researcher and that interviews were taking place with selected teachers. Most of the teachers selected were from the departments of social and natural sciences which had the potential of dealing with waste management. After being grated the permission by the head of school, the researcher went on to conduct the interviews as planned.

3.4.4 Conducting the interviews

The majority of the interviews were conducted face-to-face with participants during the months of June to August 2022. Where face-to-face interviews were not possible (i.e. due to the availability of the teacher at the time of the researcher being present at the school, or the location of the school, etc.) telephonic interviews were conducted. Face-to-face interviews were conducted during school hours, while telephonic interviews were mainly done in the evenings and weekends when teachers were free from their work obligations. The semi-structured questionnaire was sent to interviewees at least one day before the interview was conducted. The interviews started with the researcher providing background on the research, obtaining the interviewees informed consent to conduct the interview, and requesting permission to audio record the interview (for later reference). Interviewees were guided through the three sections (Sections A, B and C) of the interview questionnaire (see Section 3.4.1 and **Appendix 1**). Approximately 30 to 45 minutes were spent per interview. The researcher captured written notes during the interview for later reference and analysis.

3.5 Description of respondents/interviewees

A total of 85 teachers were interviewed of which 53% (45 interviewees) were female and 47% (40 interviewees) were male. The ages of the interviewees varied between 25 years to above 55 years, with the majority of respondents being between 36 and 55 years of age (Table 3-3).

Table 3-3: Age category of interviewees

Age category (years)	Less than 25	26 - 35	36 - 45	46 - 55	Above 55
Number of respondents	3	18	29	29	6
Percentage of total respondents	3.5%	21.2%	34.1%	34.1%	7.1%

All of the respondents were qualified secondary school teachers, teaching from Grade 8 up to Grade 12 (with 20% teaching to Grade 8, 22% teaching to Grade 9, 21% teaching to Grade 10, 19% teaching to Grade 11, and 19% teaching to Grade 12 pupils).

The interviewees teach across a spectrum of subjects according to their training specialisation (Table 3-4). Many of the teachers were responsible for teaching more than one subject. The most frequently taught subjects were Life Orientation, Geography, History, Mathematics, English Language and Natural Sciences (Table 3-4).

Table 3-4: Subjects taught by teachers

Subject	Frequency	Percentage
Life Orientation	20	13.3%
Geography	19	12.7%
History	17	11.3%
Mathematics	16	10.7%
English Language	15	10%
Natural Sciences	15	10%
Life Sciences	12	8%
Commercials	10	6.7%
Creative Arts	10	6.7%
Technology	6	4%
Computer Studies	3	2%
Other Subjects	7	4.7%
Total	**150**	**100%**

The number of years the interviewees have been teaching at their respective schools are indicated in Table 3-5. The majority of respondents were at their schools for more than five years.

Table 3-5: Duration which interviewees have been working at their respective schools

Duration working at the school (years)	Less than 5 years	5 – 10 years	11 – 15 years	More than 15 years
Number of respondents	27	29	16	13
Percentage of total respondents	31.7%	34.1%	18.9%	15.3%

Approximately 31% of the participants had taught at their schools for less than five years. Teachers who had taught in their schools for five to 10 years represent 34% of the teachers interviewed, while approximately 19% of the respondents were teachers who had taught for

eleven to fifteen years. Only 15% of the respondents had been at their specific school for more than 15 years (Table 3-5).

3.6 Data analysis

Data analysis is the process of bringing order and meaning to the collected data. The analysis of data in this research involved organising, accounting for and explaining the data. The aim of the analysis was to make sense of data in terms of the participants, definitions of the situation, noting patterns, themes, categories and regulations (Cohen *et al.*, 2007). For the purposes of this research, data was reduced into themes and a coding system used and then condensing the codes and the data was then presented in figures, tables and then followed by a discussion.

The data was analysed by transcribing the recorded interviews and the written interview notes into word processing documents. The researcher used intuitive coding with different codes for different themes or categories. Overlapping themes were combined and categorised into a single code. The data identified as irrelevant to the research problem was omitted from analysis, as suggested by Leedy & Ormrod, (2015).

3.7 Ethical considerations

The researcher had to obtain ethics approval from the Faculty of Natural and Agricultural Sciences' Ethics Committee (NWU-01221-22-A9) based on a project application with minimal risk to human participants. The researcher also had to get a letter of request to conduct the research from the Department of Education and presented to all principals of selected schools. The letter was to introduce the researcher and get permission and assistance to conduct research in the selected schools. The letter was meant to introduce the research and provide evidence that the research has been authorised. The participants were assured of confidentiality and anonymity of the information they supplied during the research. The researcher followed all the necessary procedures and principles outlined in the North-West University Guideline for Masters and Doctoral Studies. The researcher obtained the respondents informed consent and were given forms to sign if they agreed to take part in the research with no coercion but their own will. All research findings are reported anonymously.

3.8 Methodological assumptions and limitations

The first limitation was that not all selected schools expressed interest in participating in the research, and not all teachers that were invited to participate in the interviews were available. Some teachers were absent from work on the day of appointment for the interview. Some interview scheduled times were disturbed by electricity load shedding.

Not all of the interviews could be conducted face-to-face, and some telephonic interviews were conducted. During telephonic interviews, it is difficult to judge non-verbal communication of interviewees (i.e. to get non-verbal signs to indicate whether they understood the question asked).

Being a teacher helped the researcher to comprehend what teachers expressed during the interview session, but the researcher had to be cautious of researcher bias.

It is important to note that this research was based on secondary school teachers' perceptions of the implementation of the waste management hierarchy. Perceptions may not always be accurate reflections of actual implementation. No observations were done to confirm the self-reported data (perceptions) of the interviewees.

3.9 Chapter summary

This chapter has discussed the research design and methodology used in this research. The qualitative research method has been detailed. Based on the characteristics of this study, the quantitative research method was adopted. Data collection methods have been highlighted. The semi-structured questionnaires and interviews have been explained to justify the rationale for the choice of method.

CHAPTER 4 RESULTS AND DISCUSSION

4.1 Introduction

Chapter 3 provided an overview of the design of the interview questions and justification for the data collection method. Chapter 4 provides results interpretation and analysis of data collected from the semi-structured interviews.

Results related to Section A of the questionnaire (demographic information of respondents) are reported in Section 3.5 of this dissertation, since it aimed to provide information on the demographic background of interviewees and were not formally part of the main research objective scope.

Sections B and C of the semi-structured survey questionnaire aimed at addressing the three research questions:

1. Understanding knowledge on and level of implementation of the waste management hierarchy within secondary schools.
2. Exploring opportunities in the implementation of the waste management hierarchy within secondary schools.
3. Exploring challenges in the implementation of the waste management hierarchy within secondary schools.

Results related to Section B (waste management hierarchy implementation in schools) are outlined in Section 4.2 (and sub-sections) and results related to Section C (opportunities and challenges experienced by schools towards implementing the waste management hierarchy) are outlined in Section 4.3 and sub-sections.

4.2 Knowledge and level of implementation of waste management hierarchy in secondary schools (RO1)

Section 4.2 provides an overview of the interviewees' perceptions of the current waste management practices implemented at their schools; their knowledge and perceptions of the waste management hierarchy (and what it entails); and their perceptions of the implementation of the waste management hierarchy in sampled secondary schools.

4.2.1 Methods of disposing waste in secondary schools

Question 1 of section B of the questionnaire asked the teachers to indicate how waste is disposed in their schools (Figure 4-1).

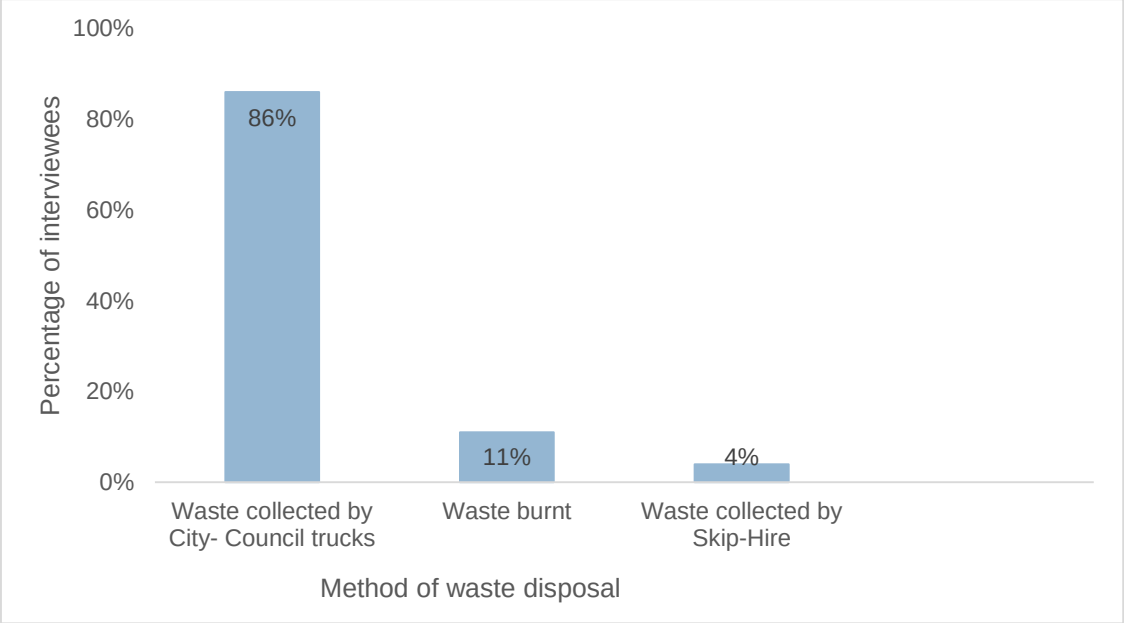


Figure 4-1: Interviewees' perceptions of how waste is disposed at their school (n = 85).

The results were categorised into three sub-categories, which included (i) waste collected by city council trucks, (ii) waste burned in the school rubbish pits for disposal and (iii) waste collected by private skip-hire trucks. None of these disposal methods were in line with the options advocated by the (reuse, recycling, treatment) waste management hierarchy.

As indicated in Figure 4-1, 73 of the participants (86%) stated that waste generated by the schools was being collected by city council trucks, while nine of the participants (11%) mentioned that waste generated at their schools was disposed through burning of the material in the school yard (mostly in rubbish pits). Only three of the respondents (4%) stated that waste was collected by a private skip-hire company. None of the participants mentioned waste being separated prior to disposal.

Research by Ifegbesan (2021) focusing on waste management in secondary schools in Nigeria also found that the majority of schools (68%) incinerated their waste or sent to landfills. Olufemi *et al.* (2019) and Nxumalo (1999) similarly stated that the waste generated by schools are mostly disposed of by means of landfilling. Nxumalo (1999) highlighted the importance of placing waste into bins (to prevent littering) at a primary school level.

4.2.2 Waste separation methods

Question 2 of Section B of the questionnaire investigated whether the schools practiced any waste separation methods. The respondents were further probed to elaborate on the waste separation methods used in their schools.

The results of the first part of the question indicated that 47 of the teachers (55%) reported that there was no waste separation practiced in their schools, while 38 of the teachers (45%) reported that waste was either separated by ground staff (ten respondents, 12%) or separated through a (formal or informal) waste separation programme (28 respondents, 33%) (Figure 4-2).

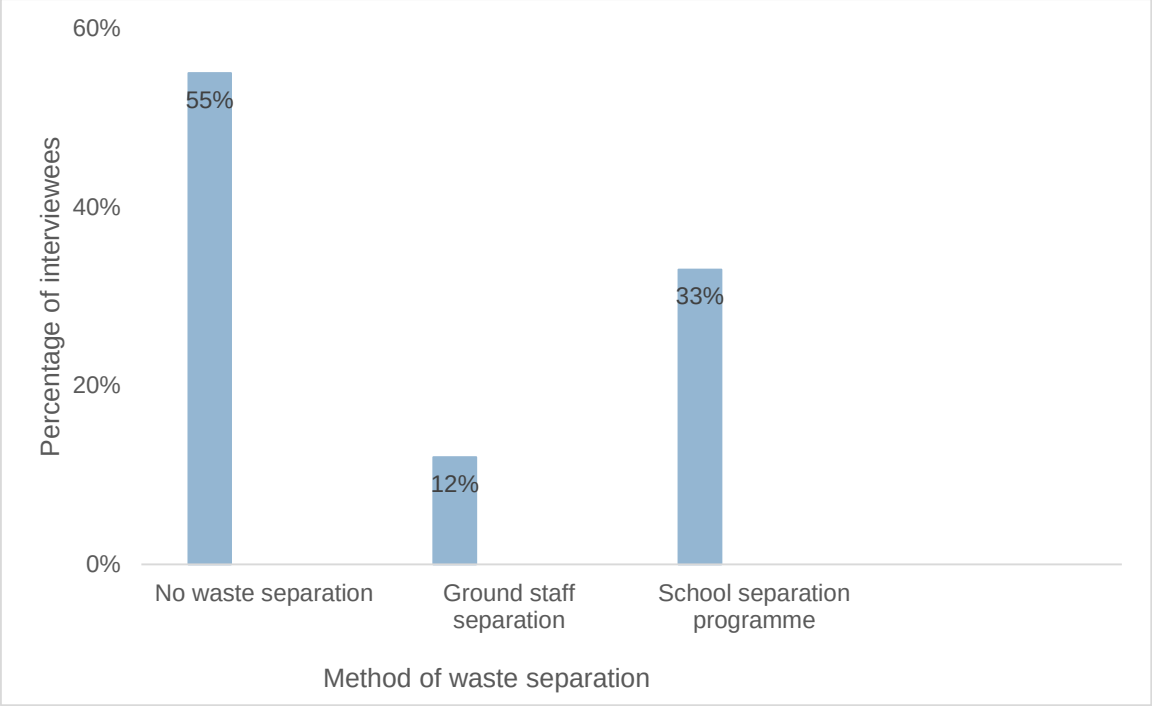


Figure 4-2:Interviewees' perceptions of how waste is separated in their schools (n = 85).

Liao and Li (2019) assert that successful waste separation begins at source and is effective on a small scale. The practice of waste separation within secondary schools would be the starting point for a successful implementation of the waste management hierarchy. Moyo (2021) found that no separation of waste took place in schools and that recycling programmes were generally not being implemented. Nxumalo (1999), similarly, reported that only limited separation at source took place in secondary schools surveyed in Edendale area in KwaZulu-Natal. The implementation of waste management practices should ideally start with separation and reuse of some of the waste material (Liao and Li, 2019).

4.2.3 Waste types separated at schools

Interviewees were requested to elaborate on the type of waste separated at their schools (Figure 4-3).

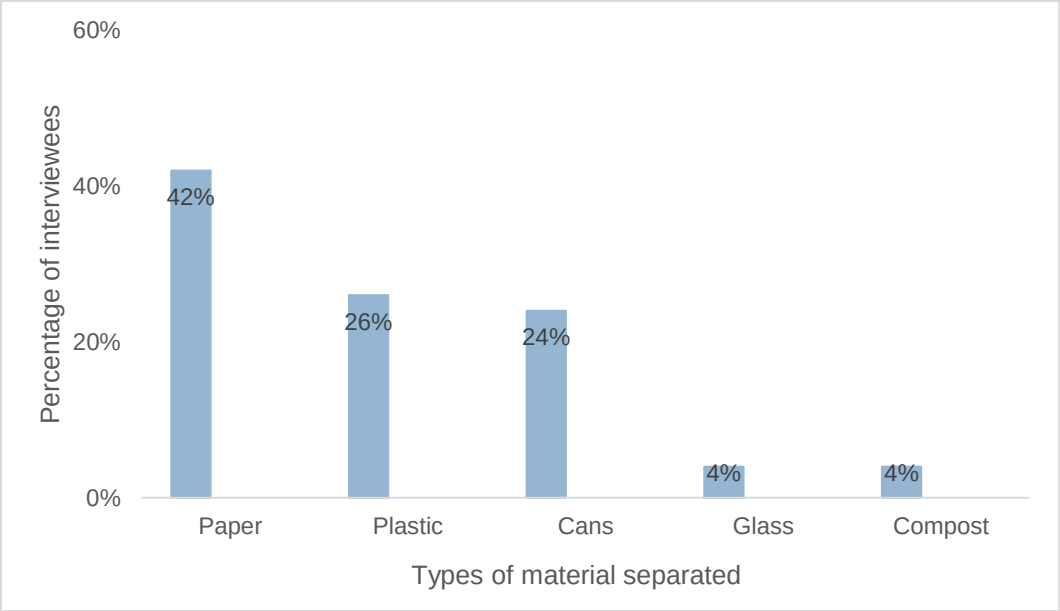


Figure 4-3: Interviewees' perceptions of the waste types separated at their schools (n = 85).

The results show that paper waste is the most frequently separated waste, with 36 (42%) of the interviewees indicating that it is separated at their schools. The next most commonly separated waste types were plastic (26%) and cans (24%). Glass and compost (or organic material) were mentioned by only three participants (4%), respectively. Paper is common because it is generated by the whole school through their daily activities. Plastic and cans are mainly generated from students' lunch packs and the tuck-shop.

Nxumalo (1999), in his study performed at schools in KwaZulu-Natal, found that the waste management hierarchy practiced in schools was limited to paper recycling and composting of organic materials and garden waste. Likewise, a study by Moyo (2021) in KwaZulu-Natal found that schools mix waste and there was no separation of waste at source, and littering at schools was evident, indicating that there were no formal waste management practices.

4.2.4 Perceptions of the "waste management hierarchy"

In order to understand whether teachers understood the concept of waste management hierarchy, they were asked to define and explain the concept (in their own words). The answers given by

teachers showed differing understandings of the concept, with some of the teachers admitting that they did not have knowledge or an understanding of the concept (asking for clarification) (Figure 4-4).

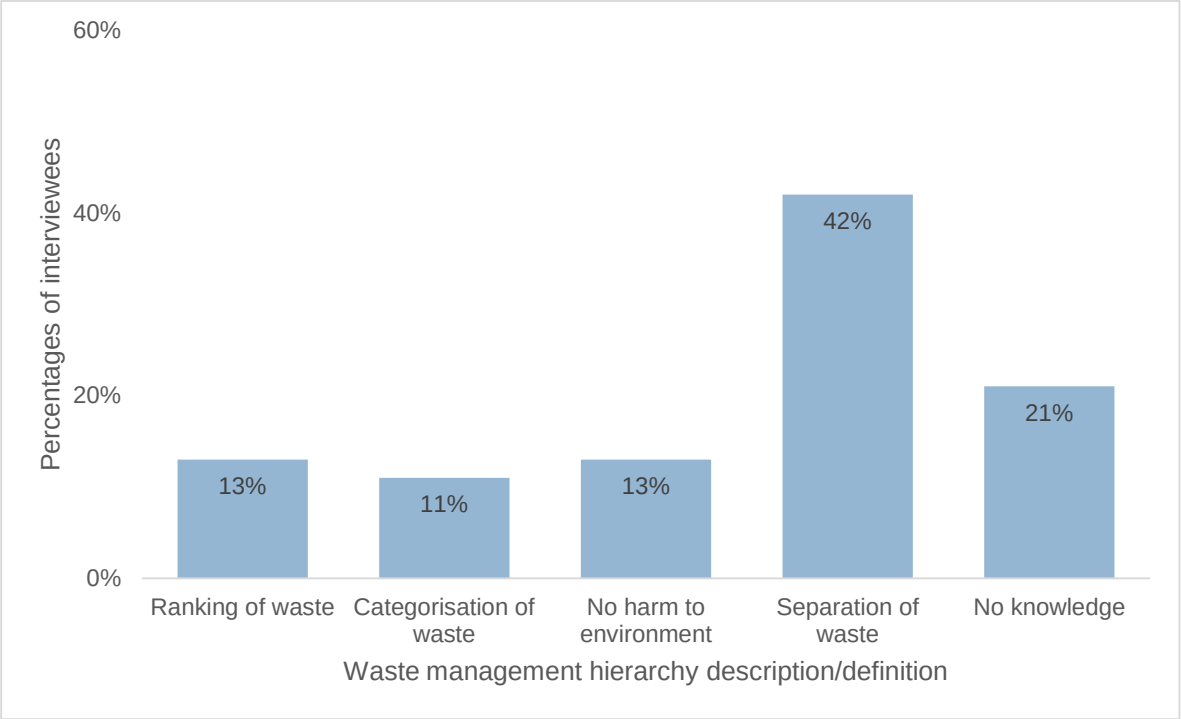


Figure 4-4: Interviewees' perceptions or definitions of "waste management hierarchy" (n = 85).

The majority of participants (42%) indicated that they understood the "waste management hierarchy" as being about the "separation of waste", while 13% indicated that it was a concept related to management waste so that there is no "no harm to the environment" (with reference to pollution prevention and responsible management of waste). A combined total of 24% of interviewees indicated that it was about "ranking of waste" (13%) or the "categorisation of waste". The respondents elaborated by saying that, *ranking* would *entail "deciding on the waste disposal method, whether the waste would be recycled, reused or sent straight to the waste dump site"* and that categorisation is *"a method of disposing waste in an environmentally friendly manner."* Eighteen of the teachers (21%) indicated that they had no knowledge of the concept.

The analysis of the results of this study confirms the findings of by Debrah *et al.* (2021), who stated that many teachers lack knowledge on environmental issues. Teachers also reported that they had limited knowledge on waste management issues since they had not received any formal training on waste management (Moyo, 2021). On the other hand, a study by Aksan & Celikler (2019) conducted in Turkey reported that teachers had appropriate knowledge on the waste

management hierarchy, and that they educated students on separating waste according to type (including paper, plastics, glass and cans).

4.2.5 Supporting the implementation of waste management hierarchy in secondary schools

The researcher asked teachers if they would support the implementation of the waste management hierarchy in their schools. The results from this investigation showed that all of the teachers interviewed would support programmes or initiatives towards implementing the waste management hierarchy at their schools. When probing for reasons for the support, the teachers provided different reasons and the results were categorised into themes (Figure 4-5).

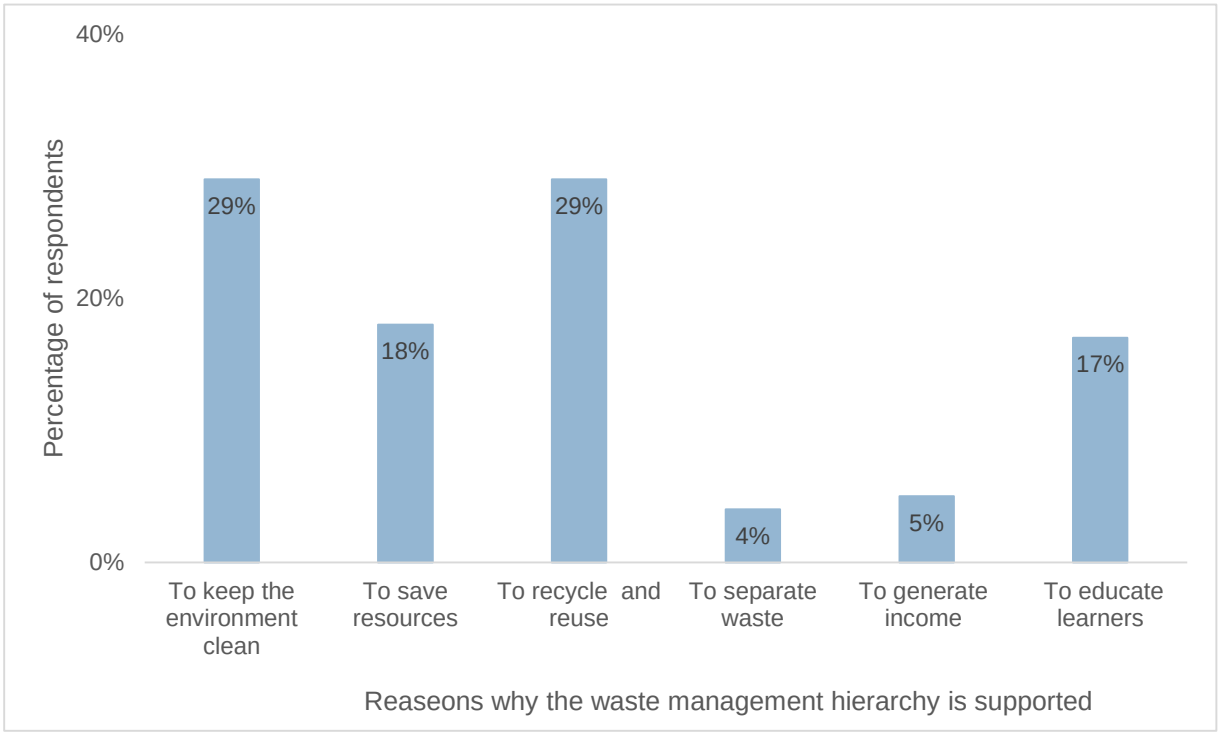


Figure 4-5: Interviewees' reasons for supporting the implementation of the waste management hierarchy (n = 85).

The first reason, given by 29% of the respondents, was directed at "keeping the environment clean". The participants argued that the environment would be kept clean by collecting waste materials for potential use and diverting waste away from landfill sites. "To recycle and reuse waste" was also mentioned by 29% of the respondents, and three of the teachers (4%) specifically mentioned "waste separation". Other reasons for supporting the implementation of the waste management hierarchy included: to save resources (18%), to educate learners (17%) and to generate income (5%) (Figure 4-5).

Limited research exists on the factors influencing teachers to support the waste management hierarchy. Reasons for households being willing to engage in activities related to the waste management hierarchy, cited by Banga (2013), included that separation of waste depends on the level of awareness of recycling activities and educational levels. Banga (2013) also noted that increasing access to recycling facilities would promote separation of waste activities. Mrema (2008) contends that increased education may also be motivation for implementing the waste management hierarchy at schools.

4.2.6 Perceptions of teachers on the implementation of waste management hierarchy in schools

Question 5 sought to investigate the opinion of educators whether their schools were doing enough to promote the waste management hierarchy. The results indicate that most teachers are of the opinion that their schools were not doing enough on the implementation of the waste management hierarchy. Only 27% of the respondents believe that their schools are doing enough to promote the waste management hierarchy, while a significant number of teachers (73%) were of the opinion that their schools are *not doing enough* to promote the waste management hierarchy in schools.

Respondents who were content with the situation of waste management hierarchy in their schools (27%) believed that their schools had adequate bins everywhere and students had been informed about recycling and reuse of waste material. The teachers further say their schools had advertisements and campaign posters to inform their school community on the waste management hierarchy. The schools were already separating waste and sending waste material for recycling and reuse.

The large group of teachers who were of the opinion that their schools were not doing enough to implement the waste management hierarchy (73%), said that waste was not being separated in their schools. The schools do not have daily programmes on waste management issues, and the schools had no bins for the placement of different waste material generated in their schools. The teachers also blamed the administration of the schools for failing to embrace the waste management hierarchy concept or making it a priority. The teachers further alluded that it was the school ground staff, who had (informally) taken the initiative in collecting recyclable waste material for their own ends. The schools did not have any educational programmes on waste management issues. A study by Ndzimbomvu *et al*. (2021) indicate that, in South Africa, the National Curriculum Statement-Curriculum and Assessment Policy Statement (NCS-CAPS) fails to address environmental literacy and waste management issues within schools.

The problems highlighted by teachers in this study are similar to those found in the study by Debrah *et al.* (2021), stating that the waste management hierarchy is not being sufficiently implemented at schools. According to Debrah *et al*. (2021) teachers are expected to provide/transfer knowledge on how to manage waste and how the waste management hierarchy could be implemented. However, teachers have been found to lack practical knowledge on the implementation of the waste management, which impedes proper implementation of the waste hierarchy in schools (Debrah *et al.,* 2021). South African schools also lack sufficient infrastructure, funding and support systems, which complicates waste management (Nxumalo, 1999).

4.2.7 Perceptions of teachers on what needs to be done to promote waste management hierarchy

Question 6 investigated teachers' perceptions on what schools need to do to promote the implementation of the waste management hierarchy (Figure 4-6).

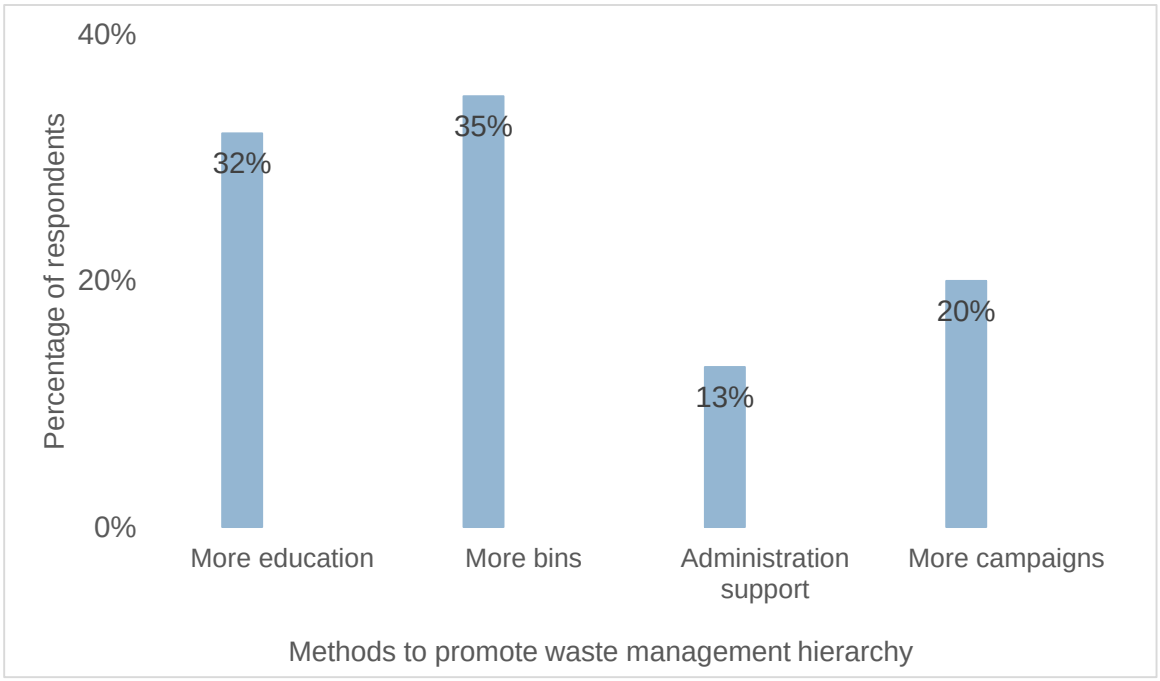


Figure 4-6: Interviewees' perceptions of methods to promote waste management hierarchy (n = 85).

The results show that many teachers were of the view that - to implement the waste management hierarchy - there had to be more bins (35%) and more education on waste management and the waste management hierarchy in schools (32%). Similarly, Karani & Jewasikiewitz (2005) mention the importance of infrastructure to improve waste management at schools, and mention that the phase in of infrastructure should be coupled with awareness on how to adequately use it (i.e.

separation of waste types into different bins). The respondents of this research believed that education of teachers and learners would be of paramount importance in achieving recycling and reuse of waste materials. Williams (2011) and Karatas (2013) assert that education is a vital factor to provide knowledge in management of waste. It is important to educate students on waste management issues so that they can learn to behave in an environmentally accountable manner. Environmental education has to be provided in schools where there is an increasing amount of waste generated (Williams, 2011). Aksan & Celikler (2019) also highlight the importance of education in the implementation of waste management issues by noting that education enables teachers to be able to categorise and recycle waste in a correct manner.

The third suggestion on how the waste management hierarchy should be implemented in secondary schools was that the school administration should take the initiative to develop and implement campaigns, programmes and policies (20%) towards formalising the implementation of the waste management hierarchy at schools. Some interviewees suggested that the Department of Basic Education should take the lead, while others suggested that the management of schools (principal and management body) should take the initiative to develop policies, programmes and campaigns.

Lastly, interviewees believed that administrative support (13%) played an important role. They argued for the appointment of administrative support staff who would be specifically responsible for coordinating activities at the school, which relates to the waste management hierarchy. Interviewees also mentioned that these staff members could be responsible for separation of waste, and for making logistical arrangements to have waste collected for reuse, recycling or recovery. Correspondingly, Karani & Jewasikiewitz (2005) emphasise the important role that an enabling environment with sufficient support/administrative staff play in implementing waste recycling initiatives.

The results of the research shows the amount of work which schools would need to undergo to implement the waste management hierarchy. It can be concluded the implementation of the waste management hierarchy would need a concerted effort from the entire school and commitment. In Nigeria, lfegbsan (2017) found that teachers, the school administration and support staff needed to be enlightened on the importance of adopting the separation of waste, getting financial support, and adequate infrastructure to implement a sound waste management programme.

4.2.8 Perceptions on whether teachers have adequate knowledge on the practice of waste management hierarchy

Question 7 investigated the opinion of teachers on the level of knowledge teachers had on the practice of waste management hierarchy (Figure 4-7). In this instance, they were not only required to reflect on their own knowledge, but to provide a reflection of the level of knowledge of secondary school teachers, in general, on the waste management hierarchy.

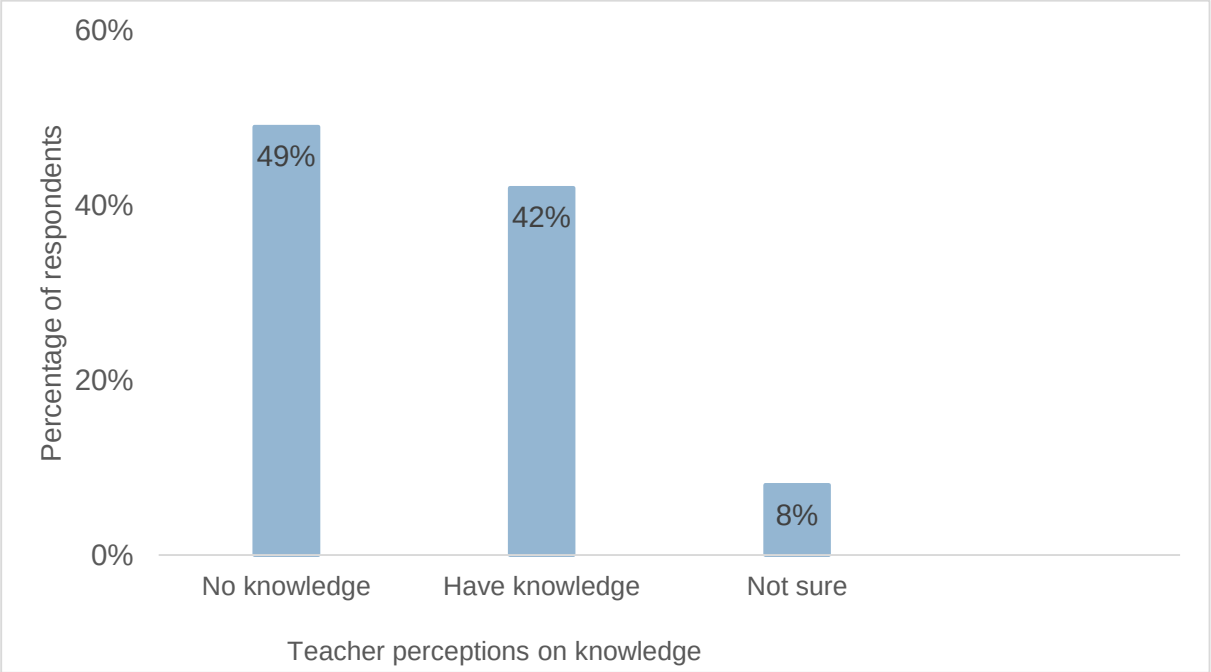


Figure 4-7: Interviewees' perceptions of adequate of teachers' knowledge on the practice of the waste management hierarchy (n = 85).

As indicated in Figure 4-7, almost half of the respondents (49%) indicated that they believed that secondary school teachers had no knowledge of the waste management hierarchy, while 42% of the respondents believed that secondary school teachers had sufficient/adequate knowledge on waste management hierarchy. Seven of the interviewees (8%) where unsure about whether teachers had sufficient knowledge about the waste management hierarchy.

The interviewees who believed that secondary school teachers had sufficient knowledge (42%) were of the view that the waste management hierarchy formed part of "common or general knowledge". It was further said that certain subjects like Creative Arts, Life Orientation and Science and Technology had projects which required learners to use recyclable and re-usable waste materials and taught basic concepts of waste management. The respondents believed that schools were not implementing the waste management hierarchy because the school administration did not take the initiative or motivate teachers to practice the waste management

hierarchy concept, and that knowledge of teachers did not necessarily play a role towards non-implementation.

The opinion of most interviewees that teachers have no/insufficient knowledge is supported by the results of Question 3 (as discussed in Section 4.2.4), where 21% of the respondents could not define the concept of waste management hierarchy. Teachers admitted that they do not have the knowledge of waste management hierarchy practice because it was not part of their job description and would only be known by teachers who teach certain subjects where waste management would form part of the curriculum. Karatas (2013) states that if teachers are not well versed with waste management knowledge, it would be difficult to transfer awareness (and even changed behaviour) to their students.

Interviewees who indicated that secondary school teachers had no/insufficient knowledge of the waste management hierarchy were asked a follow-up question to determine what is needed to acquire sufficient knowledge. These interviewees suggested the implementation of formal programmes, in-service training, integration of waste management into school curricula, waste separation campaigns, education of the larger community (outside of schools).

These suggestions align with the focus areas and activities suggested as part of the 2020 National Waste Management Strategy (DEFF, 2020), where Pillar 3 which focuses on awareness (amongst others) and highlights the role of “outreach and clean -up campaigns in schools and communities” (DEFF, 2020: 42) and “raising awareness through the school curriculum” (DEFF, 2020: 56).

4.2.9 Knowledge which teachers impart to students about waste management hierarchy

Olufemi (2019: 15) contends that knowledge about waste management from teachers would raise awareness on waste management and permeates to learners to change their behaviour to be positive towards waste management issues.

Teachers were asked an open-ended question about their perceptions regarding the knowledge that teachers impart to students about the waste management hierarchy. Responses were thematically analysed (based on the phrases captured as part of interview responses), and categorised into four categories (Table 4-1).

Table 4-1: Interviewees' perceptions on knowledge imparted to learners by teachers

Category	Examples of phrases	Frequency of mention (n = 85)	Percentage
Prevention of pollution	"Clean environment", "No pollution", "prevention of pollution", "green environment", "littering", "dumping", "waste disposed in bins"	41	48%
Reuse and recycling	"Reduce waste to landfills", "less waste to dumps", "reduce, reuse, recycle", "separate waste", "adopt 3Rs", "waste management hierarchy"	38	45%
Conservation of resources (waste as a resource)	"Save natural resources", "running out of resources", "scarcity of resources", "waste as a resource", "reduce exploitation"	19	22%
Business opportunities from waste.	"Recycling", "jobs", "employment opportunities", "income", "profit", "make a living"	9	11%

Four categories of responses emerged (Table 4-1), which included imparting knowledge on (i) prevention of pollution (mentioned by 48% of interviewees), (ii) reuse and recycling (mentioned by 45% of interviewees), (iii) conservation of resources and waste as a resource (mentioned by 22% of interviewees) and (iv) business opportunities from waste (mentioned by 11% of interviewees).

Teachers who mentioned the importance of prevention of pollution mentioned the impartment of knowledge regarding the maintenance of a "clean environment", "prevention of pollution" and addressing undesirable practices, such as "littering" and "dumping". Many teachers highlighted that they specifically address aspects such as waste reduction, reuse and recycling, while three of the interviews specifically mentioned the "waste management hierarchy" as knowledge that they impart to their students. The 22% of respondents who stated that they impart "resource conservation" knowledge to their students, also mentioned the fact that they focus on "waste as a resource" and one participant even mentioned the "circular economy where waste is regarded as a resource". Lastly, the 11% of interviewees who indicated that they focus on waste as a business opportunity, said that they impart knowledge on "jobs" or "employment opportunities" and focused on "income", "profit" or "make a living" from waste.

Debrah *et al.* (2021) state that teachers are the principal role players, with the potential to advance skills, knowledge and awareness of students towards the implementation of waste hierarchy. If teachers are well informed on waste management issues, it would be possible to educate students and create a future generation which is well-informed about the preservation of natural resources, and the impacts of waste in the environment. Likewise, Rada *et al*. (2016) argue that teachers have the ability, through knowledge transfer, to positively impact on their learners' waste-related perceptions, attitudes and behaviour. Debrah *et al*. (2021), however, highlight that teachers must have practical and specialised knowledge to transfer the appropriate knowledge to students regarding the implementation of the waste management hierarchy.

4.2.10 Willingness to be involved in activities towards implementing the waste management hierarchy

As emphasised in the discussions above, attitudes and knowledge of teachers are critical in the implementation of the waste hierarchy at schools (Debrah *et al*., 2021). The final questions in Part B of the questionnaire (Question 10 and 11) focused on teachers' willingness to be involved in activities (workshops, presentations, environmental forums/clubs) towards implementing the waste management hierarchy. All 85 of the interviewees (100%) indicated that they would be willing to participate in such activities in the future.

The results also suggested that currently many schools do not have any environmental forums/clubs to deal with waste management issues. The current lack of platforms to address waste management issues in schools, would make it difficult to implement viable and sustainable waste management hierarchy practices in schools. It is imperative that schools establish waste management platforms (networks, clubs or forums) to implement the waste management hierarchy and promote waste management issues.

Similar results were noted by Ifegbsan (2017) in Nigeria, where teachers were overwhelmingly positive towards waste management, and willing to undergo staff development programmes on waste management issues to ultimately improve waste management education and waste management measures at schools.

4.3 Opportunities and challenges towards implementing the waste management hierarchy (RO2 and RO3)

Research objectives 2 and 3 were aimed at exploring opportunities and challenges for implementing the waste management hierarchy at secondary schools. The sub-sections below report on the perceived opportunities and challenges identified by secondary school teachers. Responses were thematically analysed according to the phrases mentioned by the interviewees.

4.3.1 Opportunities for implementing the waste management hierarchy in secondary schools

Schools generate large quantities of waste, and South African schools have the opportunity to implement the waste management hierarchy. As mentioned earlier, education and awareness at school level is regarded as activities included in the 2020 National Waste Management Strategy (DEFF, 2020).

Opportunities (or mechanisms) towards implementing the waste management hierarchy at secondary schools, as identified by interviewees, are included in Table 4-2 below.

Table 4-2: Interviewees' perceptions on the opportunities towards implementing the waste management hierarchy

Category	Examples of phrases	Frequency of mention (n = 85)	Percentage
(O1) Waste separation infrastructure	"bins", "space", "fenced areas", "colour-coded bins"	35	41%
(O2) Human resource capacity	"support staff", "more staff", "employ people"	30	35%
(O3) Funding	"raise money", "acquire funds", "fund school projects"	23	27%
(O4) Competence and skills of educators	"qualified teachers", "informative teachers" "transmission of knowledge"	16	19%
(O5) Awareness of learners	"clean environment", "responsible learners", "sustainability"	9	10%

Certain opportunities/mechanisms for implementing the waste management hierarchy existed in certain secondary schools where the support staff were already collecting and separating waste material for reuse and recycling purposes.

Interviewees reflected on opportunities (or in some instances mechanisms) for implementing the waste management hierarchy at secondary schools. In many instances, the opportunities mentioned were based on current "gaps" in the implementation of the waste management hierarchy and could be seen as recommendations for improvement.

The most frequently mentioned opportunity, mentioned by 35 (41%) of the respondents was the acquisition of waste separation infrastructure (O1) (also referred to as "recycling bins"). The

respondents mentioned that the acquisition of infrastructure such as “dedicated colour-coded bins or skips” would increase the “opportunities for separation of waste at source”, which would enhance opportunities to “reuse, recycle, or sell” waste at a later stage. One of the participants also mentioned that this infrastructure could be used by the wider community (surrounding schools) to separate waste at source.

One of the interviewees mentioned that *“If we do not separate waste at source, it would end up being contaminated/mixed with other wastes, and end up in landfill. The waste would be too dirty to reuse or recycle. The school needs to purchase (colour coded) bins for the separation of waste at the point of generation. This would prevent waste from being contaminated by hazardous or other waste streams. It would also save time in sorting waste later, and this would speed up the collection process of already sorted waste materials.”*

The second most frequently mentioned opportunity was the investment in human resource capacity (O2), mentioned by 35% of interviewees. Here the interviewees mentioned the opportunity to appoint dedicated “support or administrative staff”, which could assist schools with “the facilitation and coordination of activities related to the waste management hierarchy”. The responses indicated that schools must outsource a service provider in the facilitation and coordination of waste management activities. Respondents mentioned that teachers have limited capacity to also focus on waste management, considering their current teaching and extracurricular activity responsibilities. The interviewees believed that support staff could also play an important role in “awareness campaigns” and “setting up environmental forums or clubs” which could be beneficial to the larger community. Williams (2011), similarly, mentioned the importance of having dedicated support staff for waste management in schools, and stated that the school administration should implement in-service workshops and campaigns for teachers to provide them with up-to-date information regarding waste management hierarchy.

The allocation of funding (O3) was mentioned by 23 (27%) of respondents as an important opportunity toward the implementation of the waste management hierarchy at schools. Interviewees raised the opportunities of “seeking for funds to support waste management from external parties”, but also mentioned that “contribution to recycling (in itself) could be an opportunity to make money for the school”. One of the participants mentioned that: *“Many schools are under financial stress, and the recycling projects would help to boost the school’s finances”.* Interviewees suggested that funds acquired from waste recycling could be applied to areas where funding is lacking, such as “painting of the school buildings”, “buying more recycling bins”, and “buying library books and furniture” to be used by learners.

According to Nxumalo (1999) funding was an important aspect to consider for the implementation of waste hierarchy in schools in Edendale. Adequate funding is necessary to acquire waste separation at source infrastructure (bins/bag/skips) and also towards funding specific campaigns or programmes. Furthermore, the participants in the research by Nxumalo (1999) mentioned the importance of funding towards rewards or incentives for learners who opt to engage in waste collection for recycling purposes. Ana *et al.* (2011) in their research in Nigeria, similarly, mentioned the importance of funding towards acquiring technological and social amenities and resources towards waste recycling.

Lastly, the interviewees mentioned the opportunities related to improving the competence and skills of educators (O4) (19%) and the improving the awareness of students (O5) (10%). From the responses of interviewees, it was clear that they believed that concerted efforts towards implementing the waste management hierarchy at schools would have the advantage of increasing their teachers' and students' knowledge and awareness of waste management. This would be achieved through dedicated education and awareness programmes and other platforms specifically aimed at increasing awareness.

One of the interviewees highlighted that: *"Education is key towards improving awareness and changing attitudes and behaviour towards achieving a clean and sustainable environment - as everyone would know on how to behave and enforce actions which promote the waste hierarchy in our community."*

According to Roos *et al*. (2022), increased knowledge and awareness on waste management was regarded as one of the most frequently mentioned opportunities of responsible waste management. Increased knowledge and awareness would enable the implementation of sound waste management practices through common goals, a shared vision and coordinated efforts in implementing the waste management hierarchy (Roos *et al*., 2022). As discussed earlier, environmental education has been accepted as a basic tool to positively influence the behaviour of students in secondary schools (Mahbub *et al.,* 2019).

4.3.2 Challenges of waste management hierarchy in secondary schools (RO3)

Finally, the last question posed to interviewees sought to investigate secondary school teachers' perceptions of challenges towards implementing the waste management hierarchy at schools (Table 4-3). Not surprisingly, many of the challenges mentioned by interviewees included aspects that were addressed in Part B of the questionnaire (discussed in Sections 4.2.1 to 4.2.10 above).

Teachers admitted that there were major challenges experienced in schools in the implementation of the waste management hierarchy. The challenges that were mentioned by interviewees were

thematically analysed according to the frequency of responses of specific phrases, and the five categories of challenges are outlined in Table 4-3.

Table 4-3: Interviewees' perceptions on the challenges towards implementing the waste management hierarchy

Category	Examples of phrases	Frequency of mention (n = 85)	Percentage
(C1) Administrative issues	"no administration support", "waste issues not a priority", "no funds"	46	54%
(C2) Lack of infrastructure	"no bins", "no skips", "no fenced area", "no space"	31	36%
(C3) Learner behaviour/attitude	"negative attitude of learners", "leaners not supportive", learners might sabotage the programme"	24	28%
(C4) Time constraints	"no time", "teacher co-duties more important"	22	26%
(C5) Waste management not a priority	"too little time", "teaching is a priority", "teachers loaded with administration work"	20	24%

The most frequently mentioned challenge experienced by secondary school teachers were "administrative issues" (C1), which was mentioned by 46 (54%) of interviewees. The majority of the interviewed teachers regarded "a lack of sufficient administration" as one of the critical challenges which impede the implementation of the waste management hierarchy in schools. This also relates to O2 ("human resource capacity") (Table 4-2), where respondents mentioned the increase/improvement of administrative and support human resource capacity as an opportunity towards implementing the waste management hierarchy.

Teachers mentioned it was common for the school administration to "not support initiatives, such as recycling programmes/initiatives", citing" financial constraints, insufficient human resources, or other logistical problems". They mentioned that it was the school administration's prerogative to approve or not approve any project in the school and that "environmental initiatives were many times not approved". During the discussion, 24% of the interviewed teachers revealed that the school administration "might not prioritise waste, waste management or the waste management hierarchy" (C5). This lack of prioritisation many times lead to "good ideas not even being

considered or kicking-off". One of the interviewees specifically mentioned that *"Education and learning is the priority of our school, even sport and culture are considered as important. Waste management is definitely not one of our top priorities".* The fact that waste management is not being prioritised by schools may also lead to insufficient fund allocations towards managing waste. Debrah *et al.* (2021) mention that a lack of appropriate budgeting and funding towards waste management in schools are major challenges in the implementation of the waste management hierarchy.

Related to O1 (infrastructure/bins for waste separation) (Table 4-2), 36% of respondents mentioned the current lack of infrastructure (such as bags, bins and skips) (C2) as being a challenge for implementing the waste management hierarchy at their schools, since "waste separation at source is key for implementing the hierarchy" and "inadequate infrastructure halters the separation of waste at source". Interviewees specifically mentioned that they "do not think that the school has sufficient funding to buy infrastructure for recycling". Teachers also expressed their concerns about delays in collection and non-collection of waste material for recycling or reuse once placed in the school holding places or fenced area, and highlighted that delays in collecting waste material would result in undesirable outcomes. Some of the problems mentioned included "the influx of rodents", "attracting flies", "cockroaches" and causing "nuisance and odours". They were also considered about "wind-blown litter" from skips if not collected frequently. Interviewees also highlighted that "if the waste material is not collected on time, there would be an accumulation of waste material which would result in visual impacts that could degrade the school environment". Some teachers were concerned with the lack of space in schools to implement the waste management hierarchy as "reclamation and recycling infrastructure may require a lot of space to store the waste material before collection". The problem of infrastructure challenges is experienced in many African schools. Research by Ifegbesan (2017) conducted in Ogun State, Nigeria, found that access to adequate bins were considered one of the major needs of schools that is necessary for the implementation of recycling programmes.

Learner behaviour/attitude (C3) was mentioned as a challenge by 28% of the interviewees. The teachers believed that "learners may have a negative response to embrace the concept of waste management hierarchy in schools". Teachers lamented the negative attitude of learners as they perceived learners as "not being interested to partake in waste management issues in schools". It was also said that learners would not support the waste management hierarchy "as they do not understand its importance", and it was believed that this would result in "learners not co-operating and would ultimately sabotage the programme and bring it to a halt". Moyo (2021) found that learners in schools do not show interest in participating in waste management issues, while

Nxumalo (1999), likewise, reported that students are not motivated to value waste management or implement the waste management hierarchy.

The fourth most frequently mentioned challenge towards the implementation of waste management hierarchy in schools (mentioned by 26% of interviewees) was the “time factor” (C4). The responses indicate that teachers “do not have time” to implement the waste management hierarchy because their “teaching programme is already overwhelmed by too many commitments in the mornings and extra-mural activities in the afternoon”. Teachers said they would “fail to monitor the waste management programmes if initiated in their schools hence the waste management is bound to fail as there is no support for it”. This challenge relates to C1 (human resource capacity) which was discussed earlier. In research by Debrah *et al*. (2022) teachers also cited exhaustion from their core-teaching duties as a reason for not implementing the waste management hierarchy, as “they have no energy to implement the waste management hierarchy and other waste management related issues”.

The challenges of the implementation of waste management hierarchy found in this study are similar to the findings of Debrah *et al*. (2021) who mentioned a lack of resources, logistics, lack of student commitment and failure by the school administration to support and implement waste management programmes. The study of Debrah *et al.* (2021), further highlights the lack of commitment from teachers as one of the major barriers to implement a waste management hierarchy within schools. The attitude of teachers is critical in the implementation of the waste management hierarchy in schools.

4.4 Chapter summary

This chapter discussed the results related to the three research questions. The next chapter deals with the conclusions and recommendations of the study.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This research aimed to explore the perceptions of teachers on the implementation of the waste management hierarchy within secondary schools. To achieve this aim, three objectives were set:

1. Understanding *knowledge on and level of implementation* of the waste management hierarchy within secondary schools.
2. Exploring *opportunities* in the implementation of the waste management hierarchy within secondary schools.
3. Exploring *challenges* in the implementation of the waste management hierarchy within secondary schools.

This chapter highlights the conclusions related to the major findings, as well as recommendations, and areas for further research.

5.2 Conclusions

The next sections outline the conclusions related to each of the three research questions. The conclusions are based on interviews with 85 teachers from 29 secondary schools in the Ekurhuleni North District in Gauteng, South Africa.

5.2.1 Conclusions related to RO1: Knowledge and level of implementation of the waste management hierarchy within secondary schools

The first objective was to *understand the knowledge and level of implementation of the waste management hierarchy within secondary schools.*

The results show that schools generate waste streams (such as paper, plastic and cans), with the potential to be moved “up the waste management hierarchy”. The majority of waste generated at sampled schools is sent to landfills (86%). These results are similar to the findings of Nxumalo (1999), Olufemi *et al.* (2019) and Ifegbesan (2021), who found that waste generated at schools are generally sent to landfill or incinerated at the schools.

Liao and Li (2019) assert that successful waste separation begins at source and is effective on a small scale. The practice of waste separation within secondary schools would be the starting point for a successful implementation of the waste management hierarchy. More than half of the teachers interviewed (55%) indicated that their schools did not practice any separation of waste, while 12% of interviewees indicated that the ground staff separated or reclaimed certain waste

streams, informally, for potential recycling. Only 33% of the respondents indicated that their schools had implemented some sort (formal or informal) of separation/ recycling programmes.

When teachers were asked about their perceptions of the concept “waste management hierarchy”, divergent opinions existed about what it entailed. The majority of participants (42%) indicated that they understood the “waste management hierarchy” as being about the “separation of waste”. Although many of the teachers were not able to correctly define the concept of the waste management hierarchy, they at least had some idea of some of the elements related to the hierarchy, such as separation, recycling, reuse, and others.

All of the teachers interviewed indicated that they would support the implementation of the waste management hierarchy at their schools, because they realised the benefit towards keeping the environment clean, saving resources and contributing to the education of their learners. Limited research exists on the factors influencing teachers to support the waste management hierarchy. Reasons for households being willing to engage in activities related to the waste management hierarchy cited by Banga (2013), included that separation of waste depends on the level of awareness of recycling activities and educational levels.

Only 27% of the respondents believed that their schools were doing enough to promote the waste management hierarchy, while a significant number of teachers (73%) were of the opinion that their schools are not doing enough to promote the waste management hierarchy in schools. Respondents in the research by Debrah *et al.* (2016; 2021) also believed that the waste management hierarchy was not sufficiently being implemented at schools.

Teachers suggested that education (32%), more bins (35%), campaigns focused on waste management (20%) and administrative support (13%) were necessary to promote the waste management hierarchy at schools. These suggestions were similar to the recommendations made by Karani & Jewasikiewitz (2005), Williams (2011) and Karatas (2013), where these authors specifically highlight the importance of education and awareness, and knowledge of teachers on waste management.

Karatas (2013) states that if teachers are not well versed with waste management knowledge, it would be difficult to transfer awareness (and even changed behaviour) to their students. About half of the respondents perceived secondary school teachers to have adequate knowledge of the waste management hierarchy, while the other half raised concerns about teachers not having the necessary knowledge to impart to their learners.

Rada *et al*. (2016) argue that teachers have the ability, through knowledge transfer, to positively impact on their learners’ waste-related perceptions, attitudes and behaviour. Respondents

reported that teachers impart knowledge to their learners on prevention of pollution, reuse and recycling, conservation of resources, and business opportunities from waste – which relate to the waste management hierarchy.

All of the teachers interviewed (100%) reported that they would be willing to participate in programmes, forums or activities towards implementing the waste management hierarchy at their schools.

5.2.2 Conclusions related to RO2: Exploring opportunities towards implementing the waste management hierarchy at secondary schools

The 85 respondents were asked to identify *opportunities towards implanting the waste management hierarchy at secondary schools*. The responses were thematically analysed, and five themes emerged, namely (i) the acquisition of waste separation infrastructure, (ii) the increase of human resource capacity, (iii) acquisition of funding towards waste management, and increasing the (iv) competence and skills of educators, and the (v) awareness of learners.

In many instances, the opportunities mentioned were based on addressing current "gaps" or challenges in the implementation of the waste management hierarchy and could be seen as recommendations for improvement.

The most frequently mentioned opportunity, mentioned by 41 of the respondents was the acquisition of waste separation infrastructure (O1), while the second most frequently mentioned opportunity was the investment in human resource capacity (O2), mentioned by 35% of interviewees. Williams (2011), similarly, mentioned the importance of having dedicated infrastructure (bins/skips) and support staff for waste management in schools, and stated that the school administration should implement in-service workshops and campaigns for teachers to provide them with up-to-date information regarding waste management hierarchy.

The allocation of funding (O3) was mentioned by 27% of respondents as an important opportunity toward the implementation of the waste management hierarchy at schools. According to Nxumalo (1999) funding was an important aspect to consider for the implementation of waste hierarchy in schools in Edendale. Adequate funding is necessary to acquire waste separation at source infrastructure (bins/bag/skips) and also towards funding specific campaigns or programmes.

Lastly, the interviewees mentioned the opportunities related to improving the competence and skills of educators (O4) (19%) and the improving the awareness of students (O5) (10%). From the responses of interviewees, it was clear that they believed that concerted efforts towards implementing the waste management hierarchy at schools would have the advantage of

increasing their teachers' and students' knowledge and awareness of waste management. This would be achieved through dedicated education and awareness programmes and other platforms specifically aimed at increasing awareness. According to Mahbub *et al.* (2019) and Roos *et al*. (2022) increased knowledge and awareness on waste management was regarded as one of the most frequently mentioned opportunities of responsible waste management by respondents in their research.

5.2.3 Conclusions related to RO3: Exploring challenges towards implementing the waste management hierarchy at secondary schools

The third objective of the study was *to explore challenges which exist within secondary schools in the implementation of the waste management hierarchy*. Five main themes emerged from the thematic analysis of responses, namely: (i) administrative issues, (ii) a lack of infrastructure, (iii) learner behaviour/attitude, (iv) time constraints and (v) waste management not being a priority at schools.

The most frequently mentioned challenge experienced by secondary school teachers were administrative issues (C1), which was mentioned by 54% of interviewees. The majority of the interviewed teachers regarded "a lack of sufficient administration" as one of the critical challenges which impede the implementation of the waste management hierarchy in schools. This also relates to O2 ("human resource capacity"), where respondents mentioned the increase/improvement of administrative and support human resource capacity as an opportunity towards implementing the waste management hierarchy. During the interviews, 24% of the teachers revealed that the school administration "might not prioritise waste, waste management or the waste management hierarchy" (C5). The fact that waste management is not being prioritised by schools may also lead to insufficient fund allocations towards managing waste. Debrah *et al.* (2021) mention that a lack of appropriate budgeting and funding towards waste management in schools are major challenges in the implementation of the waste management hierarchy.

Approximately 36% of respondents mentioned the current lack of infrastructure (such as bags, bins and skips) (C2) as being a challenge for implementing the waste management hierarchy at their schools. The problem of infrastructure challenges is experienced in many African schools. Research by Ifegbesan (2017) conducted in Ogun State, Nigeria, found that access to adequate bins were considered one of the major needs of schools that is necessary for the implementation of recycling programmes.

Learner behaviour/attitude (C3) was mentioned as a challenge by 28% of the interviewees. Moyo (2021) found that learners in schools do not show interest in participating in waste management issues, while Nxumalo (1999), likewise, reported that students are not motivated to value waste management or implement the waste management hierarchy.

The fourth most frequently mentioned challenge towards the implementation of waste management hierarchy in schools (mentioned by 26% of interviewees) was the "time factor" (C4). The responses indicate that teachers "do not have time" to implement the waste management hierarchy because their "teaching programme is already overwhelmed by too many commitments in the mornings and extra-mural activities in the afternoon". This challenge relates to C1 (human resource capacity) which was discussed earlier. In research by Debrah *et al*. (2022) teachers also cited exhaustion and no time as reasons for not implementing the waste management hierarchy at schools.

5.3 Recommendations

Schools and other educational facilities may learn from the opportunities and challenges towards implementing the waste management hierarchy reported in this research. Management and administration of schools should aim to leverage the opportunities mentioned, and to find means of addressing gaps or challenges identified. The findings of this study revealed that many teachers did not clearly understand the concept of the waste management hierarchy, and highlighted sufficient knowledge of teachers on waste-related matters as a concern. The results of the research may be used as a foundation for planning interventions, such as workshops and in-service programmes for teachers on waste management issues.

Given the attention that the National Waste Management Strategy (DEA, 2011; DEFF, 2020) provides towards education and awareness on waste management within schools, the Department of Basic Education together with the Department of Forestry, Fisheries and environment should consider formulating policies or procedures towards implementing the waste management hierarchy within schools. These departments could also aim to implement formal programmes towards increasing the knowledge and capacity of school teachers on waste management.

5.4 Areas for further research

The study focussed on the perceptions of teachers towards implementing the waste management hierarchy in secondary schools in Ekurhuleni District, Gauteng. Future research may be expanded to include other education institutions in other geographical areas in South Africa.

Valuable findings could also be gained if stakeholders' perceptions, such the Department of Basic Education, parents and learners are explored. The correct ethical procedures should, however, be followed if the inclusion of minors is considered in future research.

Another area of potential research could be the focused on exploring teachers' and perceptions on other environmental issues within schools.

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APPENDIX 1: INFORMED CONSENT FORM & QUESTIONNAIRE

Introduction

You are being requested to participate in an interview of educators of their perception of waste management hierarchy. The purpose of the interview is to gather more in-depth responses from educators from secondary schools in Ekurhuleni North, Gauteng.

You were purposely selected as a possible participation in this study because your participation in the survey conducted in 2022 to determine perception of teachers on the implementation of the waste management hierarchy within secondary schools in Ekurhuleni North, Gauteng.

Interview procedure

If you have agreed to participate in this interview, you have been requested to do the following:

- Indicate a time and date when you will be available for an interview in the month of June and July. The interview should take no more than 45 minutes of your time.
- Indicate whether you prefer to be interviewed in person, telephonically or Microsoft Teams.

Please also consider whether you agree to the recording (audio only) of the interview to ensure that it can be accurately transcribed. The recording will be deleted as soon as it has been transcribed. You will have the right to review and edit the audio recording if you so choose.

Confidentiality

The recordings from this interview will be kept as confidential as possible. No individual identities will be used in any reports or publications resulting from the interview. All transcripts will be given codes (e.g. Respondent 1) and stored separately from any names or any direct identification of participants. The information gathered from this interview will be solely used for this research and nothing else.

Potential risks and discomforts

No risks or discomforts are foreseen. In the event that a risk is identified, or discomfort is experienced, the interview will be stopped. You further have the right to end the interview at any time and for any reason.

Potential benefits to the interviewee and /or education fraternity

The research will contribute to the development and implementation of waste management hierarchy in secondary schools in South Africa. Your contribution to the interview will ensure that we have a representative sample of teachers on the implementation of the waste management hierarchy within secondary schools.

Compensation

No compensation can be offered for participation in the interview.

Withdrawal

You may withdraw from the interview at any time and do not have to provide a reason.

Ethics approval

The Faculty of Natural and Agricultural Sciences Ethics Committee (FNASREC) approved this study (Ref number: NWU-01221-22-A9) and classified it as falling into the risk category.

Contact details of the interviewer

Cell: 0681373850 / E-mail maphosaclement@yahoo.co.uk

INTERVIEWEE CONSENT

I _____ confirm that the above information was explained to me in a language and in manner that I understood. I further confirm that I am older than 18 years of age and hereby volunteer to take part in the study.

Signature_____Place_____

Date_____

RESEARCHER CONFIRMATION

I _____ hereby confirm that the contents of this document was explained to the participant in a language and manner that he / she could understand.

Signature_____Place_____

Date_____

SECTION A: DEMOGRAPHIC INFORMATION

1. Please indicate at which secondary school you are presently teaching:

2. Please indicate how many years you have been teaching at this school:

	Less than 5 years
	5 – 10 years
	11 – 15 years
	More than 15 years

3. Please indicate your gender:

	Male
	Female
	Prefer not to say

4. Please indicate your age category:

	Younger than 25
	26 - 35
	36 – 45
	46 – 55
	56 – 65
	Older than 65

5. Please indicate which grade pupils you teach to (tick all the applicable boxes):

	Grade 8
	Grade 9
	Grade 10

	Grade 11
	Grade 12

6. Please indicate the subjects that you teach (tick all the applicable boxes):

	Languages
	Mathematics
	Commercials
	Geography
	Life Sciences
	Natural Sciences
	Computer Sciences
	Life Orientation
	History
	Technology
	Creative Arts/Drama
	Any other please specify:

SECTION B: WASTE MANAGEMENT HIERARCHY IMPLEMENTATION AT YOUR SCHOOL:

1. How does your institution dispose waste generated in the school area?
2. Does your school practice any waste separation methods before disposal of waste material? If yes, please elaborate on the waste separation methods used by your school.
3. What is your understanding of the concept “waste management hierarchy”?
4. Why would you support the implementation of waste management hierarchy practice in secondary schools?
5. In your opinion, is your school doing enough to promote the waste management hierarchy? Please motivate your answer.
6. In your opinion, what should be done in your school to promote the (implementation of the) waste management hierarchy?
7. In your opinion, do teachers have adequate knowledge on the practice of waste management hierarchy? Please motivate your answer.
8. If your answer is NO, what do you think must be done to improve the situation?
9. As a teacher, what knowledge do you impart to your students about waste management hierarchy and other waste management issues?
10. Would you attend workshops and/or presentations on waste management issues if conducted in your school?
11. Would you support an Environmental forum/club which deals with waste management issues if established in your school?

SECTION C: OPPORTUNITIES AND CHALLENGES TOWARDS IMPLEMENTING THE WASTE MANAGEMENT HIERARCHY

1. Please discuss any opportunities that you school have towards implementing the waste management hierarchy.
2. Please discuss the major challenges which your school faces/may have in future towards implementing the waste management hierarchy.

Appendix 2

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE RESEARCH APPROVAL LETTER

Date:	**05 July 2022**
Validity of Research Approval:	**08 February 2022– 30 September 2022** **2022/300**
Name of Researcher:	**Maphosa C**
Address of Researcher:	**2-B Mayflower**
	7-9 Krynaum Rd
	Cason / Boksburg
Telephone Number:	**068 1373850**
Email address:	**mapclem@gmail.com**
Research Topic:	**Perception of teachers on the implementation of the waste management hierarchy within Secodnary Schools**
Type of qualification	**Master of Environmental Management Waste**
Number and type of schools:	**30 Secondary Schools**
District/s/HO	**Ekurhuleni North**

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

05/07/2022

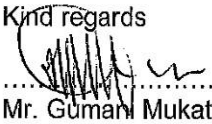
The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below are met. Approval may be withdrawn should any of the conditions listed below be flouted:

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

1. *The letter would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*
2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. ***Because of the relaxation of COVID 19 regulations researchers can collect data online, telephonically, physically access schools, or may make arrangements for Zoom with the school Principal. Requests for such arrangements should be submitted to the GDE Education Research and Knowledge Management directorate.***
4. ***The Researchers are advised to wear a mask at all times, Social distance at all times, Provide a vaccination certificate or negative COVID-19 test, not older than 72 hours, and Sanitise frequently.***
5. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s has been granted permission from the Gauteng Department of Education to conduct the research study.*
6. *A letter/document that outlines the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs, and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.*
7. *The Researcher will make every effort to obtain the goodwill and cooperation of all the GDE officials, principals, and chairpersons of the SGBs, teachers, and learners involved. Persons who offer their cooperation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.*
8. *Research may only be conducted after school hours so that the normal school program is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.*
9. *Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.*
10. *Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.*
11. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
12. *The researcher is responsible for supplying and utilising his/her research resources, such as stationery, photocopies, transport, faxes, and telephones, and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.*
13. *The names of the GDE officials, schools, principals, parents, teachers, and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.*
14. *On completion of the study, the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
15. *The researcher may be expected to provide short presentations on the purpose, findings, and recommendations of his/her research to both GDE officials and the schools concerned.*
16. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a summary of the purpose, findings, and recommendations of the research study.*

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards



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Mr. Gumani Mukatuni

Acting CES: Education Research and Knowledge Management

DATE: 05/07/2022

Office of the Director: Education Research and Knowledge Management

7th Floor, 17 Simmonds Street, Johannesburg, 2001

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