Cape Peninsula University of Technology

Im/proper solid waste disposal practices at a University in the Western Cape, South Africa.

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Declaration

I, Anani Nongoma, declare that the contents of this dissertation represent my own unaided work, and that the dissertation has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

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Signed **Date**

Abstract

Background: Improper solid waste disposal practices have become a growing concern not only in communities but also in different higher education institutions such as the university under study. Responding to this and other related challenges, South Africa is taking giant strides toward sustainable waste management through several policy formulations and the promulgations of rules and regulations. This study aims to examine factors contributing to im/proper solid waste disposal practices at a University in the Western Cape, South Africa.

Methodology: The research used the pragmatism paradigm. This paradigm was selected since the research adopted a mixed research approach, using both the qualitative and quantitative research method. Primary data was collected through participant observation, structured interviews, and questionnaires and this was enriched with secondary data in the form of scholarly literature and various policy documents. The sample method utilized was the stratified technique because the sample was divided into group/faculties.

Findings: The findings of this research highlight the necessity for higher education institutions (HEIs) to adopt comprehensive solid waste management policies that align with national regulations and sustainability goals. Moreover, the findings highlight the need for both students and staff to implement educational programs and awareness campaigns that enhance environmental knowledge and foster a culture of proper waste disposal practices within the campus community.

Conclusion: The study highlights the importance of proper solid waste disposal practices in higher education institutions (HEIs). It reveals that most students and staff engage in improper waste disposal practices, highlighting the need for comprehensive interventions to address infrastructural inadequacies and underlying attitudes towards waste disposal and management in general. A holistic approach integrating education, improved facilities, and community engagement is essential for fostering sustainable waste disposal practices. The study also emphasizes the critical role of attitudes and education in fostering responsible waste disposal behaviours. It suggests that HEIs adopt

comprehensive solid waste management policies that align with national regulations and sustainability goals.

Contribution: This study has the potential to contribute to theory, policy, and practice in terms of framework for proper solid waste disposal practices at a higher education institution and in terms of the Municipal Solid Waste. The study will contribute to making awareness of the 3 Rs of solid waste management in higher education which can directly contribute to the reduction of indiscriminate solid waste both in higher education institutions and also back in our society which in turn will reduce solid waste that reach landfill sites that are filing at an alarming rate.

Keywords: im/proper Solid waste disposal, higher education institutions and sustainable waste management.

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Dedication

This dissertation is dedicated to my late father Bonginkosi Nongoma, my mother and brother, whose unwavering support and belief in me have been my greatest motivation. To my parents, who have instilled in me the values of hard work and perseverance, and to my siblings, who have always been my cheerleaders. I am infinitely grateful for your love and encouragement.

Additionally, I dedicate this work to my supervisors and colleagues, whose guidance and collaboration have enriched my research journey. Your insights and inspiration have been invaluable.

Lastly, I dedicate this thesis to anyone who dares to dream and pursue their passions. May you find the courage and determination to follow your own path.

Abbreviations

1. DEA : Department of Environmental Affairs.
2. HEI : Higher education institution
3. IndWMPs: Industry Waste Management Plans.
4. ISWM: Integrated Solid Waste Management.
5. IWMP: Integrated Waste Management Plan.
6. NEM: WA National Environmental Management Waste Act.
7. NWMS: National Waste Management Strategy.
8. WM: Waste Management
9. SHE: Safety, Health and Environment

Key concepts

1. Solid-waste management can be described as the collecting, treating, and disposing of solid materials that are discarded because they have served their purpose or are no longer useful (Hoornweg, 2012).
2. Improper solid waste disposal is a method of disposing solid waste without taking necessary measures such as recycling or re-use of waste (Abdullahi *et al*., 2014).
3. Landfills are places where large amounts of waste are disposed of and buried in large holes covered by layers (Collins English Dictionary, 2020).
4. Recycling is defined as a process of converting waste into usable material (Waite, n.d.).
5. Re-use- is a process of repeatedly re-utilizing a waste product over and over without transforming it (Waite, n.d.).

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CHAPTER 1

INTRODUCTION

1.1 Background

South Africa is taking giant strides towards sustainable waste management. This is through several policy formulations and the promulgations of rules and regulations. Despite this effort, waste management still faces major setbacks (Adeleke, Akinlabi, Jen and Dunmade, 2021*).* Solid waste management has been a major concern for many countries worldwide and over the last decades it has received tremendous attention because of the unavoidable challenges associated with it (Jiyane and Schoeman, 2020). Polasi, Matinise and Oelofse (2020) further claimed that Waste management has become a major environmental issue in South Africa. Solid Waste Management (SWM) is a multifaceted problem with political, socioeconomic, and institutional implications (Debrah, Vidal and Dinis, 2021). Effective SWM mitigates adverse health and environmental impacts, conserves resources, and improves the liveability of cities (Abubakar, Maniruzzaman, Dano, AlShihri AlShammari, Ahmed, Al-Gehlani and Alrawaf, 2022).

1.2 Solid Waste Management

Solid waste is defined as by-products from animal and human activities or waste that is discarded because it is considered unwanted and useless because it has lost its value. As LeBlanc (2019) points out that solid waste comprises materials such as plastic, paper, glass, metal, and organic waste. Solid waste may have both an environmental and a health impact (Adeleke, Akinlabi, Jen and Dunmade, 2021), hence, the need for it to be managed to avoid both environmental and health problems. Solid waste management (SWM) is a complex process which involves different stages or steps, namely: collection, transportation, recycling, resource recovery and disposal of solid waste generated in an area (Lema, Mesfun, Eshete & Abdeta, 2019). These authors further report that solid waste is not well managed in developing countries due to high generation and production. This study will cover the last element in the solid waste management process which is solid waste disposal. This is because improper solid waste disposal practices are the

main cause of environmental and health problems, especially when solid waste is disposed of in uncontrolled or illegal dumping sites.

1.3 Solid waste in HEIs

Owojori, Mulaudzi and Edokpayi (2022), argue that Students and Staff of Higher Educational institutions (HEIs) are regarded as major stakeholders of an institution and key agents of transformation in society. As Roos (2016) further asserts, higher education institutions are better placed to take the lead in environmental protection and sustainability practices and more specifically, in solid waste management since they are regarded as agents of change in society and the key role players in the success of sustainable development (Dagiliūtė, Liobikienė, & Minelgaitė, 2018). Hence, the environmental knowledge of both staff and students in HEIs play a key role in enabling them to seek and find a solution to the solid waste management and other environmental problems in the community and at a global level (Owojori *et al., 2022).* This can be achieved through, for instance, the understanding of factors that contribute to improper solid waste disposal practices.

However, most higher education institutions in South Africa, (including the university currently under study) do not have a formal policy that speaks to solid waste management, especially solid waste disposal and this affects their solid waste management system. Rautenbach (2013) argues that there is limited literature on waste management practices in South African higher education institutions and this is because solid waste management, particularly disposal practices, receive less attention from higher education institutions and stakeholders. This study examines the factors affecting solid waste disposal practices at a university in the Western Cape, South Africa. The outcomes of the study may guide solid waste policy formulation and contribute in narrowing the identified gap in literature on solid waste management at higher education institutions in South Africa.

1.4 Problem statement

Improper solid waste disposal practices have become a growing concern not only in communities but also in higher education institutions in South Africa and globally. Solid waste generation is one of the major challenges within universities because of lack of proper waste management facilities, insufficient knowledge of solid waste impacts, and limited information about recycling, resulting in low recycling participation (Jiyane & Schoeman, 2020). This is in a context where HEIs are expected to use their expertise and capacity to increase awareness, knowledge, access to technology and tools necessary to promote and sustain best practices within and around the communities in which they are located (Coker, Sridhar, & Donnett, 2016). Jiyane and Schoeman (2020) further argue that HEIs are considered to have a similar characteristic of a small town in terms of population size thus it can be said that they generate equivalent solid waste that needs to be disposed properly. This is problematic because most HEIs do not have the same resources/infrastructure for solid waste management like a “small town” would have.

The increase in the number of students, staff membersdirectly contribute to the increase of solid waste generated in HEIs in South Africa (Geronimo and Geronimo, 2018). The South Africa: National Waste Management Strategy (2020) reports that South Africa is experiencing severe constraints in terms of the availability of landfill space, as well as challenges in operating and decommissioning landfills in a manner that is compliant with licensing conditions. For example, it was reported that in 2017 South Africa generated 55 million tons of general waste, with only 11 % diverted to landfills. It is also expected that global waste will increase to 3.40 billion tons by 2050, which accounts for more than double the growth rate of the population over the same time (Mir, Cheema & Singh, 2021). South Africa is no exception to this increase in waste generation.

Consequently, improper solid waste practices in higher education contribute to the alarming filling rate of landfill sites which leads to both environmental and health problems, aquifer contamination which also affects the health of people who use water from the contaminated aquifer (Njoku, Edokpayi & Odiyo, 2019). Also, the absence of gas

capture in landfills contributes to methane generation, which is a potent greenhouse gas, which contributes to climate change (National Waste Management Strategy, 2020). Improper solid waste can cause irreparable damage. Thus, it is paramount to divert waste from landfills.

Existing literature in developing countries covers municipal solid waste disposal practices in general, with little attention on improper solid waste disposal practices taking place in higher education institutions (Roos, 2016). Efficient solid waste management in HEIs is important because according to Moqbel (2018), improper solid waste management practices, particularly improper solid waste disposal practices in HEIs are carried back home by both students and staff.

Like any other human community, HEIs generate recyclable solid waste. However, the lack of knowledge and negative attitudes toward the environment translate to improper solid waste disposal practices in HEIs. Furthermore, improper solid waste disposal practices in higher education institutions are caused, amongst other things, by the lack of policies and programs that speak about and promote solid waste management, particularly proper solid waste disposal practices, and the lack of infrastructure such as waste segregation bins which make it easier for waste recycling. Also, some higher education institutions in the Western Cape Province and elsewhere suffer from the challenge of inadequate infrastructure such as bins, which is one of the factors contributing to improper solid waste disposal. A study conducted by Warambwa, Wayi, Kasozi and Von Blottinz in 2010 at the University of Cape Town revealed that even though there can be infrastructure that promotes proper solid waste disposal, most higher education institution stakeholders still practice indiscriminate solid waste disposal. Rautenbach (2013) further claimed that indiscriminate solid waste disposal in higher education institutions is further exacerbated by a lack of literature that can assist in expanding knowledge and awareness about best solid waste disposal practices in a higher education institution.

1.5 The rationale and significance of the study

Despite various initiatives being employed to fostering sustainability and to globally achieve Agenda 2030, the understanding of the practices, discourses, and waste management approaches of higher education institutions (HEI) remain limited (Abdulghaffar & Williams, 2021). There is limited literature on solid waste management practices and, more specifically, solid waste disposal practices within higher education institutions. Where some literature on solid waste management in higher education institutions exists, it only covers solid hazardous waste management in health facilities associated with some higher educational institutions (Adeniran, Nubi & Adelopo, 2017). Given the fact that waste is completely unavoidable in any and every human activity (Starovoytova & Namango, 2018), it is paramount to master how and why waste is handled, stored, collected, and disposed of in particular ways, since this equips members of society or institutions to keep the environment clean, pleasant or healthy. Thus, knowing factors that contribute to improper solid waste disposal practices should ensure that those factors are dealt with, contributing to the process of seeking to achieve improved solid waste disposal practices.

Higher education institutions play an essential role in innovation and knowledge diffusion, as they are agents of improvement in society (Tangwanichagapong et al., 2017). Therefore, studying the factors underlying improper solid waste disposal practices in higher education institutions should generate insights that reflect on the situation in the broader society. Given the knowledge gap that was highlighted above, this study will then contribute to the limited available literature on solid waste disposal practices in higher education institutions. Once the underlying factors contributing to improper solid waste disposal practices are known, it will be easier to come up with solutions and recommendations, which may include making use of waste hierarchy (reduce, reuse and recycle) before waste disposal. The Department of Higher education should benefit from the recommendations of the study for policy formulation and the broader society may also draw on the results of the study to improve the way they deal with solid waste and more particularly, disposal practices.

More specifically, the institution may be able to come up with measures that will combat such practices, for instance, add more infrastructure such as recycling bins. The findings of the study may assist the institution and other stakeholders that may read the report to formulate a waste policy document as per the guidelines of the Department of Higher Education and Training and national waste legislation which is administrated by the Department of Environmental Affairs and Fisheries.

1.6 Research questions

- What are the factors that contribute to indiscriminate solid waste disposal practices at the campus of the selected university?
- Is infrastructure for solid waste disposal on campus adequate?
- What are the improper solid waste disposal practices that occur on the campus of the selected university?

1.7 Aim

To evaluate the im/proper solid waste disposal practices at a selected university in the Western Cape Province, South Africa, identify the underlying factors.

1.7.1 Sub-research objectives

- To determine the kind of im/proper waste disposal practices taking place on the selected campus for this study.
- To assess the availability and adequacy of solid waste disposal infrastructure on the selected campus for this study.
- To examine factors contributing to improper solid waste disposal practices on a selected campus of the university selected for study.

1.8 Dissertation outline.

The thesis is presented in five chapters. This section gives a brief introduction of the chapters in order to outline the sequential flow of the different parts of the dissertation.

Chapter 1 Introduction

This chapter presents the introduction (background, problem statement, the rationale, significance of the study, the research questions, aim and the research objectives).

Chapter 2: Literature review

This chapter undertakes a review of literature related to factors contributing to im/proper solid waste disposal practices at a University in the Western Cape, South Africa**.** The review revealed a knowledge gap which the study seeks to narrow.

Chapter 3: Research methodology and design

This chapter discusses the research methodology for this study. It starts by giving a philosophical stance followed by a general background and comparison of the concepts guiding research design. It further explains the main components of the research design model found most suitable and adopted in this study and explains reasons for the methodological choices, considering the key elements of validity and reliability.

Chapter 4 Findings and discussions

This chapter presents data, or the results obtained and discusses these to respond to the research questions explored in the study. Secondary literature is drawn upon to complement primary data, to enrich the study.

Chapter 5 Recommendations and conclusion.

This chapter summarises the overall research undertaken in pursuing the research objectives. The conclusions reached are then presented and the research limitations are discussed. The chapter also presents recommendations that can improve current practices and recommends further research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Solid waste is any material that is discarded for its perceived lack of value, and it emanates from various sources, including from industrial and domestic activities (Achor, Ehikwe & Nwafor, 2014). Improper solid waste management (SWM) is a critical environmental problem with direct effects on both environments, and public health (Debrah *et al*., 2021). Despite the existing literature on indiscriminate solid waste disposal, and its impact on both the environment and public health, people continue to practice improper solid waste management (Tweneboah-Kodua & Asomanin-Anaman, 2020; Mohammed & Eyasu, 2017). Indiscriminate solid waste disposal practices have been covered by many authors, but it has received less attention in the context higher education institutions (Zohori and Chin, 2017: 40) when compared to the attention given to other environmental problems such as water pollution in this context.

Considering the gravity of the problem of improper solid waste disposal. Rasmeni and Madyira (2019) argue that 90% of solid waste is disposed of in dumps and landfills in South Africa and in other developing countries instead of being re-used or recycled. For instance, about 33 percent of waste is openly disposed of or dumped in uncontrolled sites. Though unrelated to the objectives of this study, it is significant that a higher percentage of lower income members of society dispose of refuse in open dumps. Furthermore, Past studies have shown that in Southern Africa, South Africa has the third-highest municipal waste generation per capita of 2kg per person per day after Seychelles and Comoros, with 2.98 kg and 2.23 kg per capita per day, respectively (Kawai & Tasaki, 2016). Since South Africa is among the top 3 Southern African countries with a high waste generation rate, it is important to undertake more studies on proper solid disposal methods as current waste management practices have not appropriately responded to the high volume of waste generated. Higher education institutions contribute to the above-mentioned waste generation, and they can also play a vital role in reducing generation and improper solid

waste disposal through environmental education, that specifically deal with proper solid waste management. Furthermore, higher education institutions can contribute to the policy development and regulation. The challenge of open dumps is not unique to South Africa as the World Bank (2018), reported that over 90% of waste in developing countries is dumped in open dumps due to the lack of infrastructure designed for waste management, or due to the insufficiency of landfill sites. As Kaza, Yao, Bhada-Tata and Van Woerden (2018) indicate that 93 percent of waste (see Figure 1) is burned or dumped on roads, open land, or waterways in developing countries.

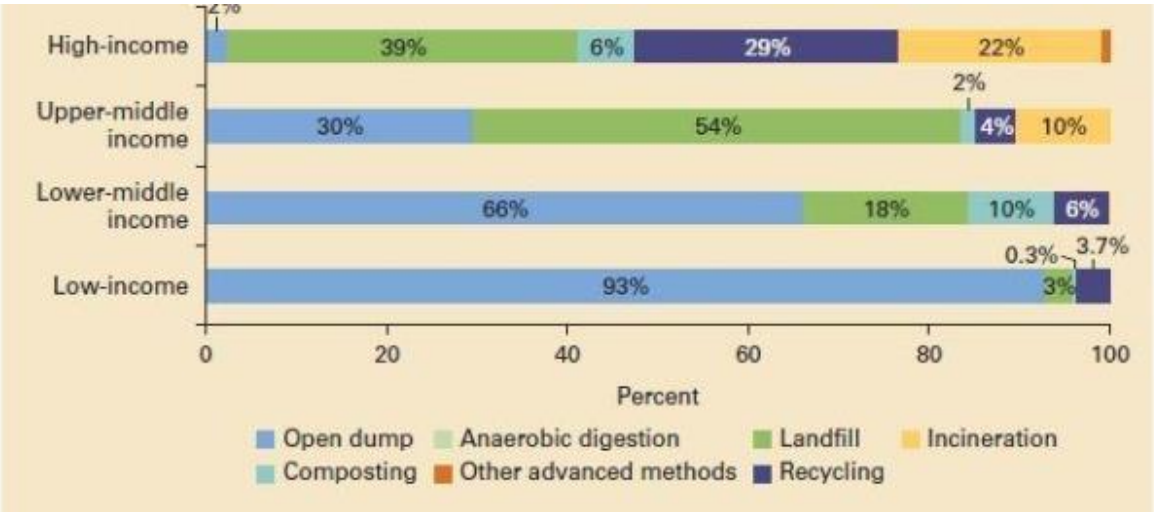

Figure 2.1: Illustration of how waste is disposed of per income of a country on a global scale (Kaza, et al., 2018:35).

Considering the dumping practices illustrated in Figure 2.1, it is useful to study improper solid waste disposal practices in the context of a university, to generate literature that may contribute insights that assist in limiting the filling of landfills and mitigating other environmental impacts that may result from improper solid waste. Hashem (2020) reports that solid waste management encompasses the disposal, collection, transportation, sorting and recycling of waste. Indiscriminate solid waste disposal is considered one of the main forms of improper solid waste management (Licy, Vivek, Saritha, Anies & Josphina, 2013). Indiscriminate solid waste disposal practices are more visible in fast-growing cities in both developing and developed countries (Gutberlet, 2018). However,

the most affected countries are developing countries since they lack the infrastructure that supports proper solid waste management practices, but also, due to increasing population growth. Existing landfill sites are filling up at an alarming rate in developing countries due to an exponential population growth that also occupies undeveloped land that should be used as landfill sites.

In general, people's perceptions and assumptions towards most higher education institutions are that they are clean, and that waste is disposed of responsibly and legally within those institutions. Higher education institutions are pace setters in society and if they practice or implement an adequate waste management hierarchy or system which includes reducing, reusing, and recycling waste, this could have an influence on society since there might be a large number of recyclables that can be recovered (Dangi & Agarwal, 2017). It is then important for higher education institutions to lead in research and the implementation of proper solid waste management practices. Once higher education institutions instil the culture of proper solid waste disposal methods and practices, there is a possibility that this would have an extended positive effect on the surrounding communities.

2.2 Factors affecting solid waste management.

In Southern Africa, solid waste generation has increased because of the burgeoning population, rapid urbanization rates, economic growth, and the general improvement in living standards (Fuggle & Rabbie 1994; Muzenda, 2014). The increase in waste generation greatly affects proper solid waste management activities as less than 50% of solid waste generated is collected (Debrah *et al*., 2021). The National Waste Strategy of 2020 further reports that in the absence of aggressive strategies to avoid waste generation, the volume of waste generated will increase and that will affect the effort in waste diversion to support the current landfills which are already recognized as being unsustainable in terms of airspace. This contributes to the increase of greenhouse gases.

In general, and according to Fagariba and Song (2016), factors that affect waste management practices, particularly solid waste disposal include, for instance, the public

attitude towards waste management, the failure of government or laws to enforce sanitation and the inadequate and untimely release of government funds. South Africa: The National Waste Management Strategy (2020) further claims that the Department of Forestry, Fisheries, and the Environment DFFE reported that South Africa faces improper solid waste management practices due to the following issues amongst others, littering, low levels of waste segregation, lack of infrastructure for recycling, lack of recycling culture, lack of education and inadequate awareness in some districts. Consequently, HEIs are directly affected by the above-mentioned issues compounded by the fact that their solid waste ends up being treated as Municipal Waste.

2.3 Environmental attitude and behaviour

Rosa and Collado (2019), assert that when people recognize values of nature which include amongst others, life support value, recreational value, scientific value, aesthetic value. Past research in SWM has explored the influence of cognitive, sociological, and psychological variables on environmental behaviour (Raghu & Rodrigues, 2020). Environmental problems such as indiscriminate solid waste disposal can be seen to mainly emanate from human activities related to individuals' attitudes and behaviour towards nature or the environment (Erhabor & Don, 2016). Therefore, the solution lies in changing the behaviour and attitude of people towards the environment (Milea, 2009; McAllister, 2015). Environmental attitudes and behaviour can be changed through environmental education and awareness that can translate to Environmental knowledge. Environmental knowledge is a key factor in shaping environmental behavioural intentions (Liao, 2019). Thus, public awareness and attitudes about solid waste can affect the whole Solid Waste Management System (Zhu, Asnani, Zurbrugg, Anapolsky, & Mani, 2007; McAllister, 2015). Furthermore, Licy et al. (2013) report that people continue to adopt improper solid waste disposal practices although they are aware of the negative consequences of such practices. This behaviour is caused by the attitude people have towards environmental protection and conservation, hence, a positive attitude towards the environment is seen as the cornerstone of effective environmental protection. As Gugssa, Aasetre & Debele (2020) suggest, it is important to deepen people's connection

to nature, increase environmental knowledge, promote positive attitudes, and motivate individuals to engage in environmental conservation and management activities.

Attitudes towards the environment determine whether people take environmental protection seriously or not. Attitudes towards the environment are conceptualized as in Liefländer, 2014; O'Connell, 2011 as beliefs, opinions, feelings, and emotions towards the environment. Liefländer, 2014; O'Connell (2011) further suggest that attitudes towards the environment depend on factors such as age, gender, cultural background, experience, rural-urban areas, knowledge, social norms, public participation mindset, education, and awareness of effective waste management techniques. These factors are the driving force behind behaviour that can contribute to im/proper solid waste disposal practices. As a result, waste means different things to different people (Moore, 2012; McAllister, 2015). For instance, to waste pickers, waste is a resource while to other people it is a burden or trash which does not have value (McAllister, 2015).

2.4 Education and Awareness

Environmental knowledge and attitude are influenced by environmental education (Liao and Li 2019). Environmental education is defined as a process of infusing environmental content into the educational system in order to enhance people's awareness of environmental issues, influence their attitudes and motivate their actions towards environment conservation and protection (Erhabor & Don, 2016). On the other hand, environmental awareness has to do with people reflecting on their natural surroundings and on the role, they play or could play in protecting the environment against any harmful action (Thor & Karlsudd, 2020). The lack of or inadequacy of environmental education in higher education institutions leads to poor knowledge about community, regional and global environmental issues by staff and students of higher education institutions, especially in many developing countries. Environmental knowledge is defined as one's ability to identify some symbols, concepts, and behaviour patterns related to environmental protection (Liao and Li, 2019). The absence or inadequacy of environmental education in most countries is responsible for the poor environmental quality in those countries (Nwachukwu, 2014). Hence, it is assumed that environmentally

literate people will show more responsible behaviour in protecting the environment (Shamuganathan & Karpudewan, 2015; Stevenson, 2007; Veisi et al., 2019).

It is reported that the solution to indiscriminate solid waste disposal lies in increasing environmental education and awareness (Maddox, Doran, Williams & Kus, 2011; Desa, Kadir & Yusooff, 2012). Thus, there should be outreach programs for faculties within higher education institutions that offer environmental protection-oriented courses since skills and knowledge gained from environmental education might help in changing people's behaviour and attitudes towards the environment. Although environmental education is one of the keys tosolving indiscriminate solid waste disposal, it has been given little attention by scholars (Desa, Kadir & Yusooff, 2012).

Taking into consideration the students' attitude and their behaviour toward the environment, the possible factors capable of enhancing environmental consciousness are recognising the importance of the environment, awareness of concerns about environment, environmental culture, active participation in environmental issues, and voluntary environmental action, heeding environmental warnings, adopting recycling following guiding principles of environmental education. Figure 2.2 below shows the model of environmental education which gives a basic knowledge of and understanding of the relationship between the environment and education while highlighting the importance of first-hand experience of nature outside the classroom but also showing how environmental education is concerned with values, attitudes and positive actions of people.

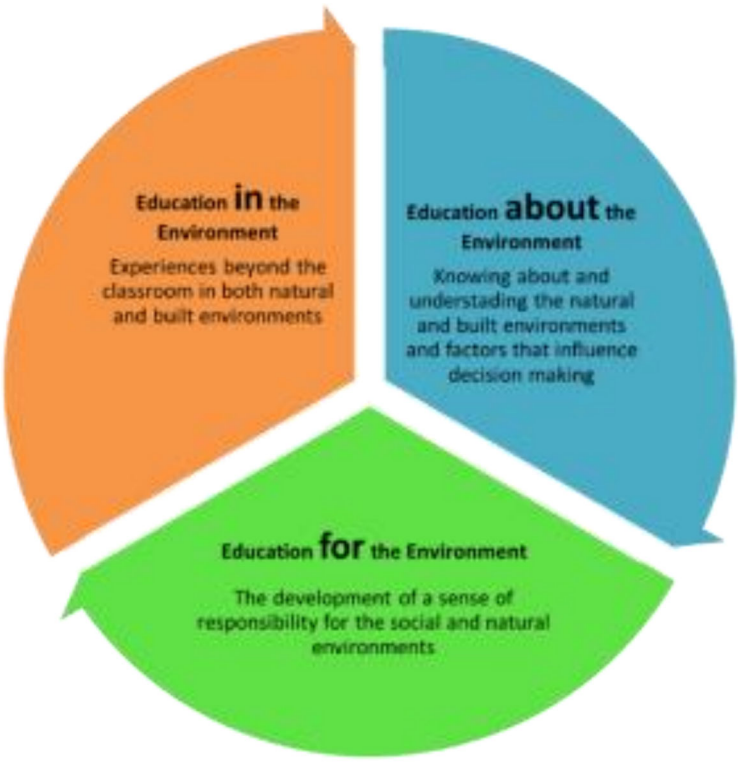

Figure 2.2: The interdependence of environment and education/awareness.

2.5 Solid waste management practices in universities

Higher education institutions form part of the major contributors to municipal solid waste (MSW) (Jayaprakash & Jagadeesan, 2020). For this reason, higher education institutions carry the responsibility to train students to engage in proper solid waste disposal practices (Moqbel, 2018). This would have significant impact as members of higher education institutions come from communities, and they would apply the knowledge learnt to their homes and communities. Additionally, the higher education sector plays an important role in sustainability, including the sustainable use of the environment. If higher education institutions do not practice proper solid waste management, they contribute to the challenge of achieving sustainable environmental protection or achieving a sustainable healthy environment (Tu, Zhu, & McAvoy, 2015). Integrated solid waste management programmes in higher education institutions are very important as they have a direct impact on whether there is environmental degradation of both higher education

institutions and surrounding communities or not (Smyth, Fredeen & Booth, 2010; Tu *et al*., 2015).

2.6 Solid waste management practices in South African universities

As Rautenbach (2013) points out, there is limited literature on waste management practices in South African higher education institutions. Most higher education institutions in South Africa do not have a formal policy that deals with solid waste management, especially a policy that speaks about waste disposal practices. These institutions rely upon departments that have environmental science/management programs, such as the Department of Environmental and Occupational Studies at the university selected for this study to provide education on waste management within the institutions. Proper solid waste management can be better achieved in higher education institutions if the solid waste disposal hierarchy is embedded in all courses of study and implemented through different approaches (reduce, re-use and recycle). For instance, the use of paper can be reduced by using soft copies where possible. Although solid waste can be managed through the waste hierarchy in South African higher education institutions tend not to adopt the waste hierarchy. This is caused by lack of knowledge, awareness, infrastructure, and willingness within higher education institutions in South Africa. Moreover, staff and students tend to feel that their contribution is too small when they are practising proper waste disposal. Thus, they end up practising improper solid waste disposal.

In a study assessing waste management at the University of Kwa Zulu Natal Howard college campus, Ntinga (2010) presents findings which revealed that 95% of students dispose of waste in bins with 35% of students indicating that the location of the bins played a pivotal role in their utilisation. Even though 95% students were able to dispose of waste, the findings still revealed that they do not adhere to the waste hierarchy before disposing of the waste in the bins, hence the waste in the university is given to a contractor to take care of it. 78% of the students revealed that they do not know anything about waste recycling. 64% agreed that they would participate if recycling programs were introduced. This study serves as a useful basis to investigate the character of the institution under

study, in terms of waste disposal practices and attitudes. The current study focusses on identifying contributing factors to im/proper solid waste disposal practices at a campus level at the selected university. Unlike the study at UKZ, the current study does not focus only on students but covers all members of the campus community

Another solid waste management related study at the university of Cape Town (UCT) by Warambwa, Wayi, Kasozi and Von Blottnitz (2010) evaluated the effectiveness of a four-bin system introduced at the main campus in the year 2009 with categories of paper, plastic, tins, and others which include non-recyclables, and a two-bin system in the self-catering residences at the waste collection point of UCT. The two bins placed in the residences included wet waste (non-recyclable) and dry recyclable waste (Rautenbach, 2013). The researchers found that from the four bins' system, the recycle bins were decreasing due to contamination. The researchers believed that the cause might be the lack of information on the part of the students on which materials are recyclable and which ones are not. In other words, these findings suggest that students are not aware of proper solid waste disposal practices. The researcher in the UCT study revealed that 61% of recyclable waste was appropriately disposed of, while 27% was improperly disposed of in the 'other' bin that was designed for non-recyclable material.

In the two-bin system placed in the self-catering residences, the findings revealed that 36% of the dry waste and 32% of the wet waste were misplaced, leading to contamination of dry waste. The fact that students mixed recyclable with non-recyclable, and wet waste with dry waste revealed that not only the lack of knowledge from the students, but the availability of enough infrastructure are also the reasons for the ineffectiveness of the system. In addition to factors such as positive attitude and knowledge, the institution currently under study does not have the infrastructure such as recycling bins. The current study aims at identifying such factors that contribute to improper solid waste disposal practices.

2.7 Case studies on waste management from selected universities

Universities play a crucial role in promoting sustainable waste management by implementing innovative strategies to reduce, recycle, and properly dispose of waste. As hubs of knowledge and innovation, campuses generate significant waste, making effective management essential for environmental sustainability. This collection of case studies explores various waste management approaches adopted by universities worldwide, highlighting challenges, successes, and best practices. By examining these initiatives, we gain insights into how institutions can foster responsible waste disposal, engage students and staff in sustainability efforts, and contribute to a greener future.

2.7.1 International case studies on knowledge, attitude, and practice of waste management in selected international universities

A study conducted by Barloa, Lapie and de la Cruz (2016) examined knowledge, attitude and practices in seeking to understand factors responsible for waste disposal practices among undergraduate students at a Philippine State University. The study found that 87.7% are aware of waste disposal practices, 87% showed a positive attitude towards waste disposal practices while only 72.5% adhered to proper waste disposal practices. The percentages mentioned were calculated using average ratings and the authors considered averages of less than 82.6% as unsatisfactory. This means that students who are following proper solid waste management practices are below the satisfactory average per the authors' scale. The above results show that knowledge and a positive attitude towards waste management practices do not necessarily translate to proper solid waste management practices. Additionally, the case of the Philippines shows that the problem of improper waste disposal practices is universal. The authors further assert that the low rate of proper practice must be addressed by changing the behaviour of students and staff towards solid waste management. Another study conducted at the Asian Institute of Technology Klong Luan in Thailand by Tangwanichagapong, Nitivattananon, Mohanty and Visvanathan (2017) suggested that the introduction of the 3R (reduce, re-use and recycle) waste hierarchy to staff and students contributed to improved environmental consciousness among staff and students.

2.7.2 Case studies on knowledge, attitude, and practice in terms of waste management in selected Africans universities

There has been less research on waste in high schools than in universities because universities are regarded as miniatures of society and sound environments for pilot programs. The study of solid waste management in HEI is conducted to involve youth in environmental initiatives as a way of nurturing conscientious citizens who care for environmental conservation and who are aware of the importance of contributing to environmentally sustainable waste management (Liao & 2019). The United Nations Educational, Scientific and Cultural Organization (UNESCO) has recommended that environmental education for sustainable development (ESD) should be incorporated into education and training programs at all levels in the “Decade of Education for Sustainable Development (UNDESD) initiative. This includes Solid waste Management. There are limited studies on solid waste management in higher education institutions in Africa. The study conducted by Adeniran, Nubi, & Adelopo (2017) at the University of Lagos which focused on Solid Waste Generation and Characterization in the University of Lagos for a Sustainable Management. Waste Management. Figure 2.3 shows the University of Lagos Akoka campus’ overall waste collected which is about 32.2 tons. Polyethene bags contribute more to the collected waste. 24% of the polythene bags come from the use of low-cost polythene packaged drinking water referred to as ‘‘sachet water” which is sold in most places on campus.

Paper forms 15% and the main contributor to the generation of paper is newspaper which is soiled and mixed with other waste materials. The low volumes of paper according to the study, especially lecture notes are associated with the introduction of a paperless policy that promotes more use of soft copies and also, the fact that some department recycle paper or sell them. Organic waste comprises 15% and the source of organic waste as per the study is food waste. The university introduced a policy for waste management which speaks to zero waste, waste recycling which also covers waste segregation through colour coding bins for effective waste segregation and also incentives to encourage stakeholders to practice appropriate solid waste management.

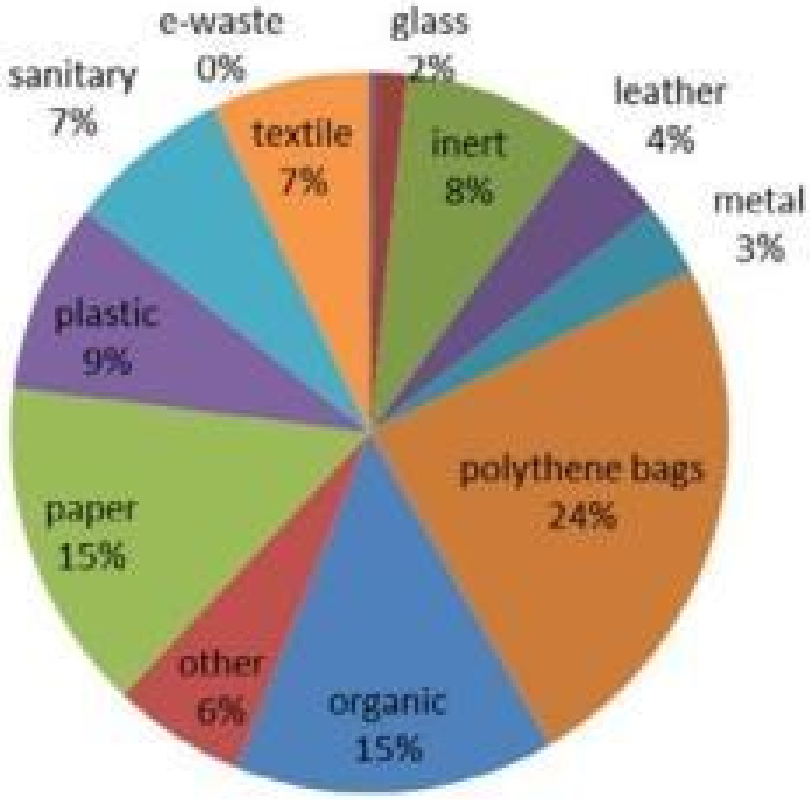

Figure 2.3: Overall waste collected at the University of Lagos, Nigeria. Source: Mbama et al. (2023).

2.8 The legislation governing waste management in South Africa

Legislation is an important instrument used by the government to harmoniously organise society and protect citizens' rights and wellbeing. However, if it is not enforced, it will have little impact or no value (Dictionary.cambridge.org., 2019). The overacting legislative apparatus in South Africa is the South African Constitution, (1996) which provides the foundation for environmental regulation and policy in South Africa. The Bill of Rights of 1996 contains therein a section (namely, section 24 of Chapter 2) that clearly sets out the right to environmental protection and the right to live in an environment that is not harmful to health or well-being. All other legislative prescripts are guided by the constitution and the Bill of Rights.

2.9 Waste legislation

The first legal framework governing waste disposal in South Africa was the Environmental Conservation Act (ECA) of 1986 (Act No. 73 of 1986). After that, the National Environmental Management Act (NEMA) No.107 of 1998) was developed. The Environmental Conservation Act was replaced by the National Environmental Waste Act (NEM: WA) in 2008 (Act No. 57of 2008) which came into effect in 2009. The ECA was replaced because it was found to be inadequate and ineffective for South African waste. The NEM: WA (Act No. 57 of 2008) was revised and amended in 2014 to improve the effectiveness of the Act in terms of waste management. The amendment of the Act resulted in the development of the National Environmental Waste Amended Act (NEM: WAA) (Act No. 26 of 2014). The daily operations of the waste act are mandated by the Department of Environmental Affairs (DEA) with co-governance from all spheres of government, from the national to the local level. In terms of mandatory provisions, the DEA is responsible for establishing the National Waste Management Strategy (NWMS), setting national norms and standards, establishing and maintaining a National Contaminated Land Register (NCLR), establishing, and maintaining a National Waste Information System, preparing and implementing a National Integrated Waste Management Plan (IWMP). The Department of Higher Education and Training (DHET) is working with DEA to solve waste-related issues in higher education institutions. Thus, in the guidelines of the DHET mandate, higher education institutions are required to have waste policies that will deal with waste-related problems.

Waste legislation is relevant for this study because the waste policies which the Department of Higher Education and Training is mandated to have, have been mandated by the Department of Environmental Affairs, Forestry and Fisheries (DEAFF). This means that every higher education institution in South Africa must develop policies in accordance with the South African waste legislation. This study will generate information that should be valuable to policy developers in higher education and specifically at the selected institution. To the knowledge of the researcher, the institution under study has not generated a waste policy that is in accordance with the guidelines of DHET and DEA.

CHAPTER 3

RESEARCH METHODOLOGY AND DESIGN

3.1 Introduction

The previous chapter provided a comprehensive review of the literature, examining key studies relevant to this research. It highlighted existing knowledge, identified gaps, and established the foundation for the current study. This chapter focuses on the research methodology adopted to address the study's objectives that were presented in Chapter 1. It outlines the research design and paradigm, explaining the rationale behind the chosen approach. Additionally, the chapter details the specific methods used for data collection and analysis, justifying their suitability in answering the research questions. This chapter also discusses ethical considerations and potential limitations of the methodology.

3.2 Research paradigm

The word paradigm is considered a philosophical assumption or the basic set of beliefs that guide actions and define the worldview of the researcher (Denzin & Lincoln, 2011). Simui, Namangal, Tambulukani and Ndhlovu (2018) further define research paradigm as a framework or perspective which guides researchers on how to conduct their studies and approach their research questions. It also encompasses a set of beliefs, assumptions, and methodologies that shape the overall approach to research within a particular discipline or field of study. There are different paradigms, namely: positivist, constructivist, and critical paradigms. Each paradigm has a different perspective on the axiology, ontology, epistemology, methodology, and rhetoric of the research (Kaushik & Walsh, 2019).

This study utilised the pragmatism paradigm. Simui et al (2018) explain, pragmatism is a research paradigm founded on the idea that researchers should employ the philosophical and methodological approach that is most effective for the research problem they are examining. It is frequently linked to mixed-methods or multiple-methods research, where

the focus is on the research outcomes and questions rather than on the methods. Both formal and informal rhetoric could be used. This paradigm was selected since the research adopted the mixed research approach, using both the qualitative and quantitative research method. By adopting pragmatism, the study remains flexible, solution-oriented, and responsive to the challenges of waste disposal on campus.

3.3 Research designs

The research design includes a detailed plan of how the data are to be collected and analysed to address each objective. Different types of research approaches can be employed in research, depending on the purpose and the nature of the study. This study adopted the mixed research approach, utilising both qualitative and quantitative data. The mixed research approach was selected because of its advantages that include amongst others complementary strengths and triangulation benefits. Complementary strength in this context means that this research approach uses the strength of one research method to enhance or support another while triangulation is a research technique that involves use of multiple methods or sources of data to increase the validity and reliability of findings (Maarouf, 2019).

A qualitative research method is used to assess the attitudes, opinions, and behaviour of the sample population through questionnaires and face-to-face interviews which are also called structured interviews (Creswell, 2014). A quantitative method was used to interpret numerical data from questionnaires and structured interviews. The questionnaires used in this study included both closed and open-ended questions. Structured interviews were used in this study and the questions used in the interviews were selected from questions in a questionnaire. By so doing, the researcher made sure that the questionnaires and structured interviews administered complemented each other in capturing the experiences and perceptions of the sample population in terms of factors contributing to improper solid waste disposal practices at a selected University within the Western Cape. According to Kumar (2011), a qualitative research design can be conducted in the following ways: case study research, oral history, focus group studies, participant observation, etc. The current study used only structured interviews and questionnaires.

Drawing on the views of Kumar (2019) structured interviews are well suited for this study as they allow for the exploration of the perceptions and opinions of respondents regarding complex issues and enable the researcher to probe for more information and clarification.

As McLeod (2018) points out, a questionnaire is a research instrument that consists of a series of questions to gather information from the respondents. Questionnaires are suitable for this research as they provide raw data which reflects the attitudes and opinions of the respondents about the study. The questionnaires were administered both physically and online via emails to the sample population which represented both staff and students of the selected Higher education institution within the Western Cape. Students and staff had the option of answering the questionnaires through the link or completing hard copies. Interviews were conducted on campus. These methods were used for the convenience of the respondents and to ensure that the researcher could capture as many staff and students as possible.

3.4 Demarcation/delimitation of the study

The selected higher education institution is in the Western Cape Province of South Africa. It is the only university of technology in the Western Cape and is the largest university in the region with an enrolment of more than 30 000 students. The selected campus is situated in Cape Town consisting of the following faculties: (1) the Faculty of Business and Management and Sciences, which is the largest faculty; (2) the Faculty of Informatics and Design; (3) the Faculty of Applied Sciences; (4) the Faculty of Engineering; and (5) the Faculty of Health and Wellness Sciences. Some courses of these faculties are based on other campuses.

Figure 3.1: Picture showing the map of the study area, the campus is marked around with a yellow line. On the left, coordinates and altitudes are shown.

3.5 Target population

The target population is the comprehensive pool from which the research sample is drawn. This group comprises of all individuals who exhibit the specific characteristics outlined in the inclusion criteria, meticulously identified to align with the focus study. Within this context, the sampling design functions as the strategic blueprint, delineating the systematic plan for selecting a representative sample from the broader target population. The target population for this study comprised the university community, including students, faculty, administrative staff, and external individuals such as visitors and service providers who also contribute to campus waste generation.

3.6 Sampling method

Probability sampling means that every respondent in the population has an equal chance of being included in the sample. The researcher constructed a sampling frame and then used a random number generation computer program to pick a sample from the sampling frame (Taherdoost, 2016). The probability sampling method, namely a stratified technique was utilised. This sampling method ensured that every individual in the target population had an equal chance of being selected, enhancing the study's representativeness and

allowing for generalisable conclusions about solid waste disposal practices. This method was used so that the sample size was divided according to different faculties of the campus to capture opinions and experiences contributing to indiscriminate solid waste disposal in every faculty. Questionnaires and interviews were conducted per faculty, and this meant that the population sample was divided into strata. This allowed all faculties (strata) to be equally represented to avoid bias in the study. The sample respondents answered the administered questionnaires and responded to structured interviews for data collection.

3.7 Sample size.

The sample size of the research depends on the size of the population and how precisely the researcher would want the results to represent the population. The sampling size for this study was obtained by using the following formula to get a true representation of the population size; $n=N/ (1+Ne^{2})$. Where n = to the number of samples (sample size), N=total population, e=margin of error. The margin of error represents the range of values below and above the sample statistic in a confidence interval. The confidence interval shows the accuracy that is desired to be achieved by the study. The confidence interval used in this study is 95%, therefore the margin of error is 0.05.

$5000(1+5000(0.5)^{2})$
$= 1251$

A total of 1251 individuals were therefore sampled.

3.8 Data collection

3.8.1 Primary data collection

In this study, the researcher collected data directly from the source or the sample population. The data collected from the source is known as primary data. The data was collected through online questionnaires and structured interviews (Figure 3.1). Primary data is essential and suitable for this study as it presents the authentic experiences of participants of this study, not the experiences of the participants in past studies. Online

questionnaires allowed for efficient, cost-effective data collection from a large and diverse sample, ensuring broad participation. Structured interviews, provided deeper insights into waste disposal behaviours and challenges, enabling clarification of responses and probing for detailed information.

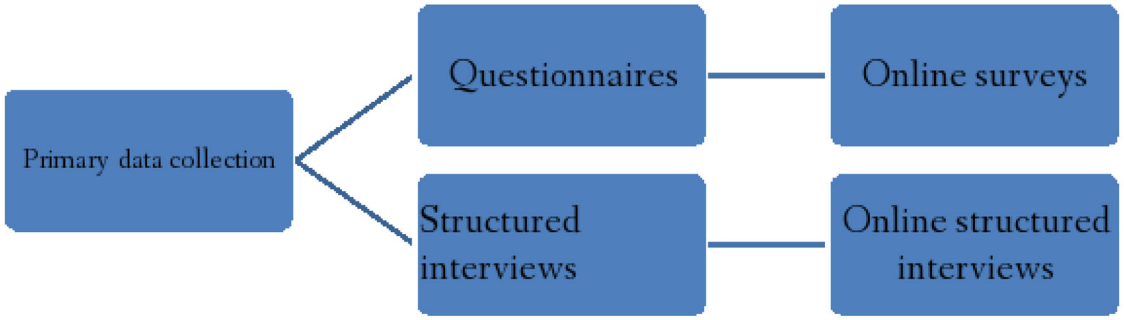

Figure 3.2: Shows the primary data collection tools that were used in the research.

3.8.2 Secondary data

Secondary data in the study was used to lay an informed background, to construct the context and the structure of the study and to supplement the primary data. Secondary materials such as journals, books, and online articles were used to support or contrast information from the findings of the primary data sources.

3.9 Data analysis

This research adopted the content analysis and framework analysis approach. Content analysis is categorising verbal or behavioural data to classify, summarise and tabulate the data. The content analyst views data as representations not of physical events but of texts, images, and expressions that are created to be seen, read, interpreted, and acted on for their meanings, and must therefore be analysed with such uses in mind. Content analysis is regarded by Kleinheksel, Rockich-Winston,Tawfik, and Wyatt (2020) as having

a high-yield potential in educational research because it is versatile and can be applied in both qualitative and quantitative studies. It is for this reason that content analysis was selected as a method of analysis in addition to the possibility that it caters to the mixed approach through summarising and tabulating data. With respect to open-ended questions in the questionnaire, the researcher coded them by taking a broader answer and assigned codes to them. The close-ended questions were transferred to Google Documents, which generated tables, graphs, and pie charts.

CHAPTER 4

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

In the previous chapter, the research methodology used to achieve the aims and objectives outlined in in this study was detailed. This included an exploration of theoretical aspects, the methods and the rationale behind the chosen methods, and the data collection process. This chapter presents the study's findings in the form of respondent views regarding im/proper solid waste disposal practices at a selected university in the Western Cape Province and a discussion. To facilitate understanding, the raw data from the interviews and questionnaires were organised into several sub-headings for in-depth analysis. The first section of this chapter engages with demographic details such as gender, occupation and faculty representation. Subsequent sections will present the study's main findings and a discussion of the findings to answer the research objectives presented in Chapter 1.

4.2 Demographic details

4.2.1 Gender of respondents

The sample was almost balanced between male and female respondents as these were respectively constituted of 53% and 47%. This is illustrated in Figure 4.1 below.

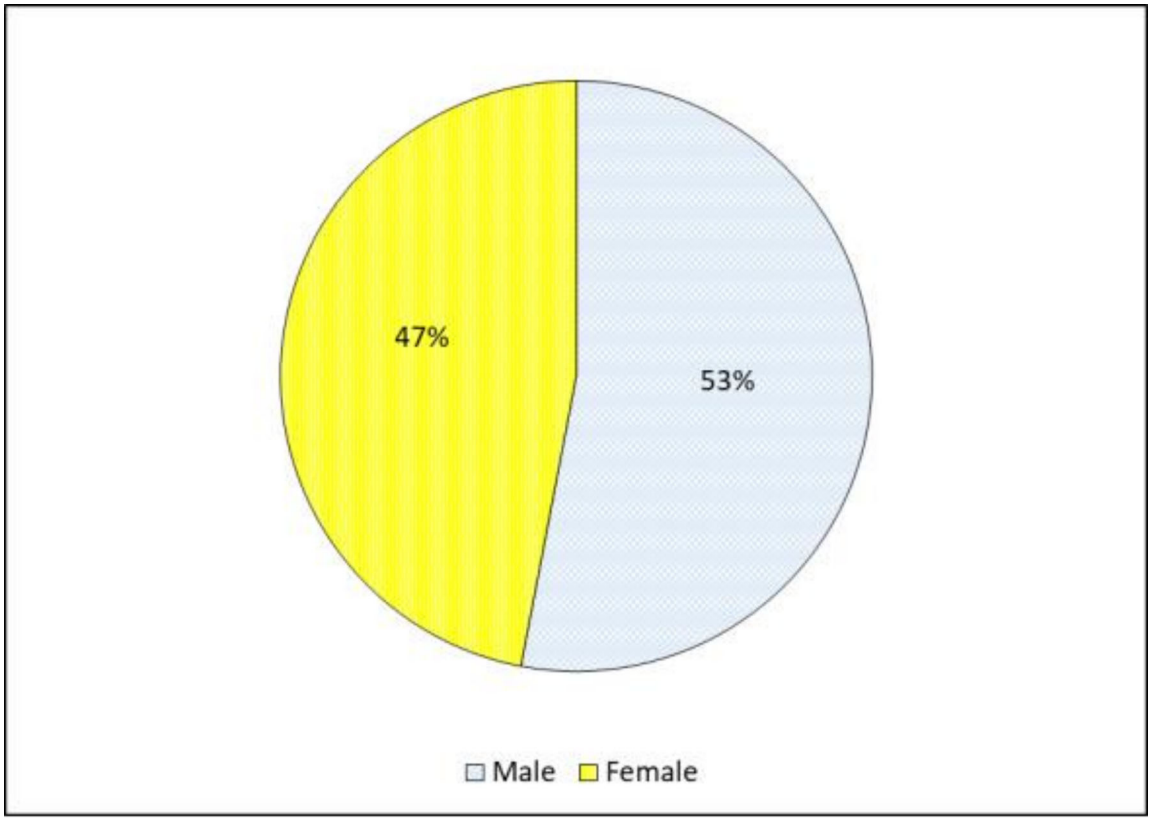

Figure 4.1: Gender of respondents

4.2.2 Occupation of respondents

Out of the respondents, 52.4% were students, 42.9% were staff members and 4.70% were external employees. This information is illustrated in Figure 4.2 below.

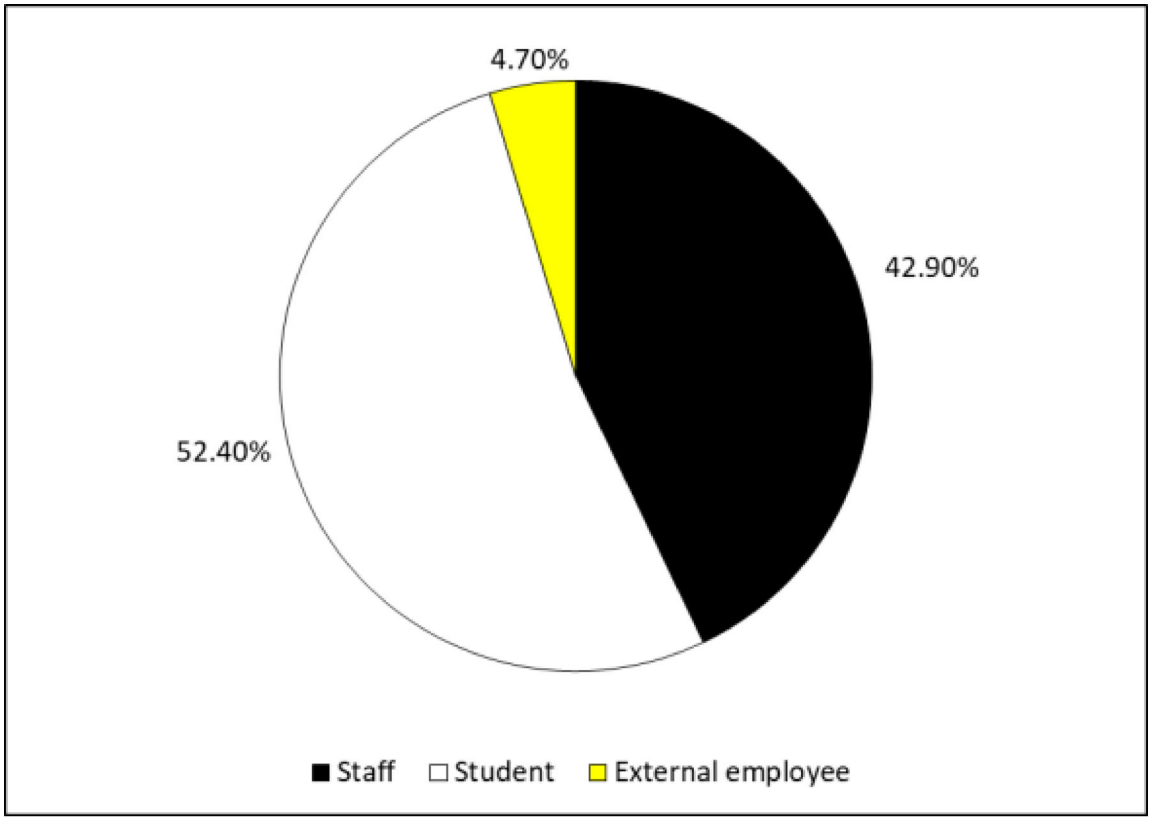

Figure 4.2: Occupation of respondents.

4.2.3 Faculty representations

The faculty representation was distributed as follows: Business and Management Sciences had the highest representation with 45.0%, followed by Applied Sciences with 20.0%. Engineering and the Built Environment had 15.0%, while Health and Wellness Sciences, and Informatics and Design each accounted for 10.0%. Figure 4.3 below illustrates these results.

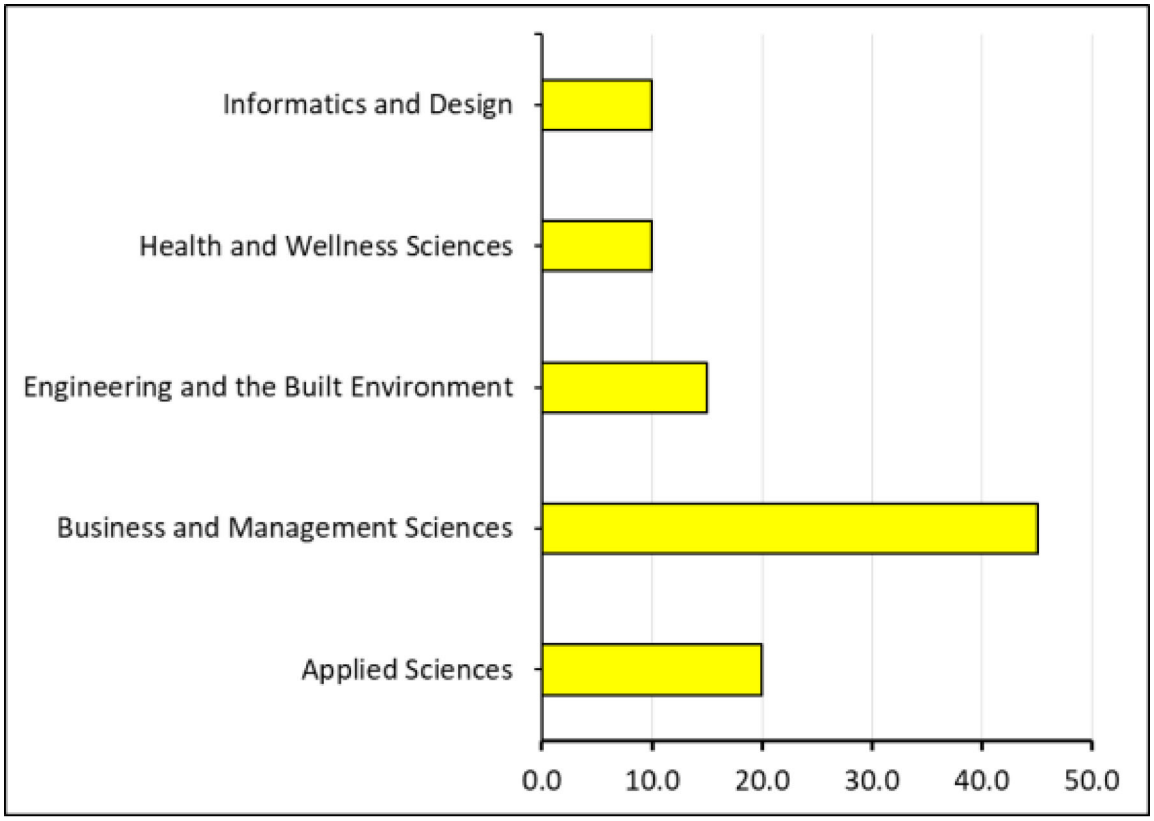

Figure 4.3: Faculty representations

4.3 Research findings

4.3.1 Status of solid waste disposal at the university

With regard to whether proper solid waste disposal was practiced at the university under study, most respondents (58.70%) disagreed while 41.30% agreed that solid waste is disposed of properly at the institution. Further analysis by gender revealed a balanced distribution in responses as among male respondents, 56.40% disagreed, while 43.60% agreed that solid waste is disposed of properly at the institution. Among female respondents, 58.90% disagreed, compared to 41.10% who agreed that solid waste is disposed of properly at the institution. These findings are presented in Figure 4.4 below.

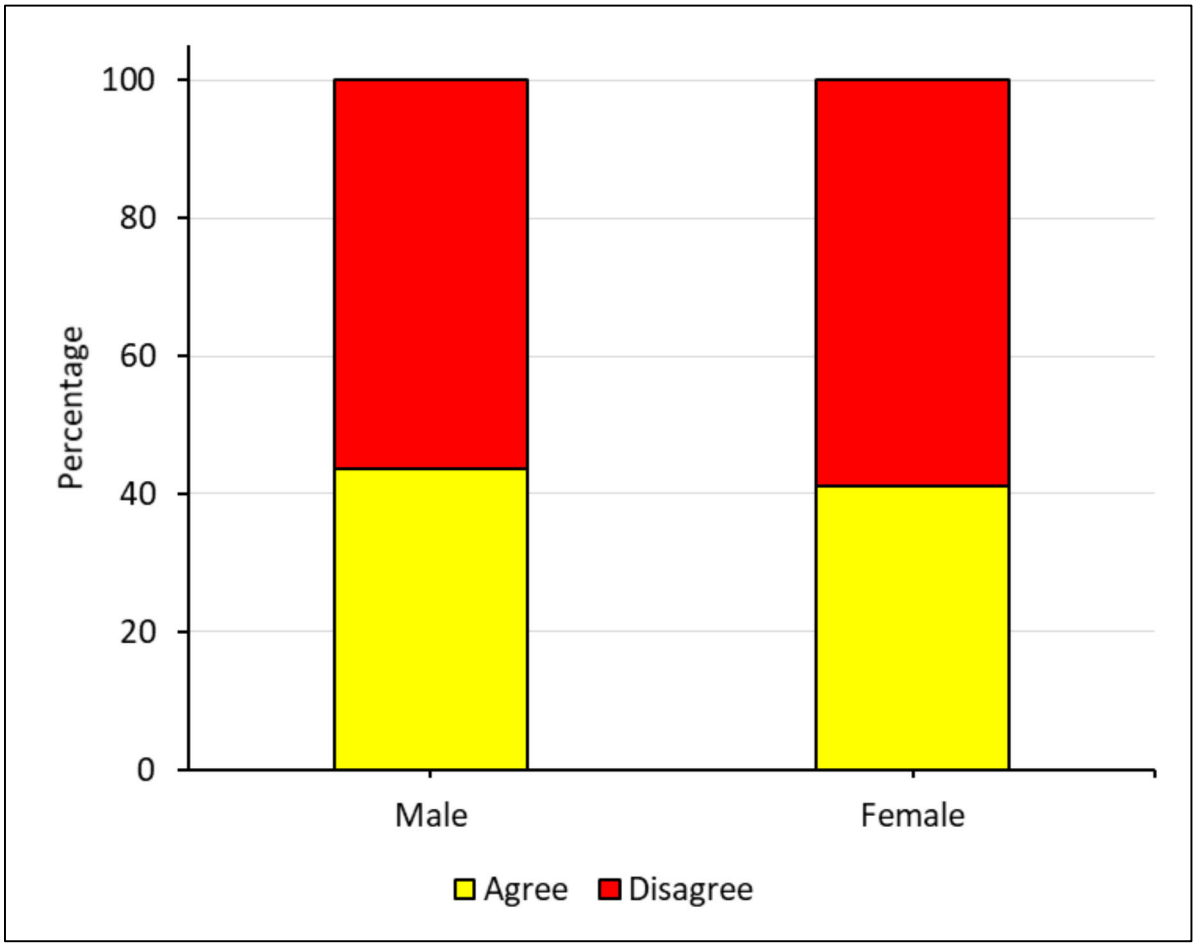

Figure 4.4: Gender specific agreement/disagreement on proper solid waste disposal at the selected University.

As the gender of the sample was generally biased towards females, gender comparisons would have resulted in results biased towards females.

When the data was disaggregated by occupation, staff (44.9% agreed, 55.1% disagreed), students (41.6% agreed, 58.4% disagreed), and external individuals (62.6% agreed, 37.4% disagreed) showed similar trends, with a slight bias toward disagreement across the staff and students, and agreement across the external individual groups. These results suggest a consistent perception of inadequate waste disposal practices by the university community except the external individuals.

Table 4.1: Excerpts from respondents highlighting their practice of im/proper solid waste disposal.

Interview question 1
Explain any instances of improper solid waste disposal that you have practiced.
Responses
R1: I do not practice Improper solid waste I throw it in the bin. *R3: Sometimes I litter if I do not see the dustbin.* *R4: Disposing glass, papers and plastics in the same place.*

The data presented in Table 4.1 was drawn from four respondents as many of the other respondents provided the same answers, as in table 1. R1 indicates that they throw waste in the bins, while R2 and R3 point out that they practice improper solid waste disposal as they dispose anywhere, they want. R4 highlights an important solid waste disposal and management challenge. This is waste segregation or a lack thereof in their case as the respondent mentioned that they mix different types of solid waste in the same bin.

4.3.2 Types of waste

The researcher asked the respondents to identify the types of waste that were prevalent and improperly disposed on campus. Plastics represented the largest portion of solid waste disposed of improperly on campus at 40%. The most visible improper solid waste practice on campus was found to be throwing take away litter around campus after eating. Paper followed with 25% of the waste, food waste constituted 15%, aluminium cans and glass bottles each made up 8% of the waste and electronics accounted for the smallest share at 4%. Table 4.2 below presents this data.

Table 4.2: Types and frequency of solid waste prevalent on campus

Waste Type	Frequency of mention
Plastics	40%
Paper	25%
Food Waste	15%
Aluminium Cans	8%
Glass Bottles	8%
Electronics	4%

4.3.3 Factors that contribute to improper solid waste disposal practices

The study identified and analysed various factors that contribute to improper solid waste disposal practices among members of the university community. The following subsections present these key factors.

4.3.3.1 Lack of knowledge and educational awareness

With regards to lack of knowledge and educational awareness as a factor that contributes to improper solid waste disposal practices among members of the university community, most respondents disagreed with the view that lack of knowledge contributes to improper solid waste disposal practices with 61.90%, (comprising 52.40% that disagreed whilst 9.50% strongly disagreed) with the view. The remaining percentage (38.10%, comprising 9.50% that agreed and 28.60% that strongly agreed), agreed that lack of knowledge and educational awareness contributed to improper solid waste disposal practices among members of the university community. These findings are presented in Figure 4.5 below.

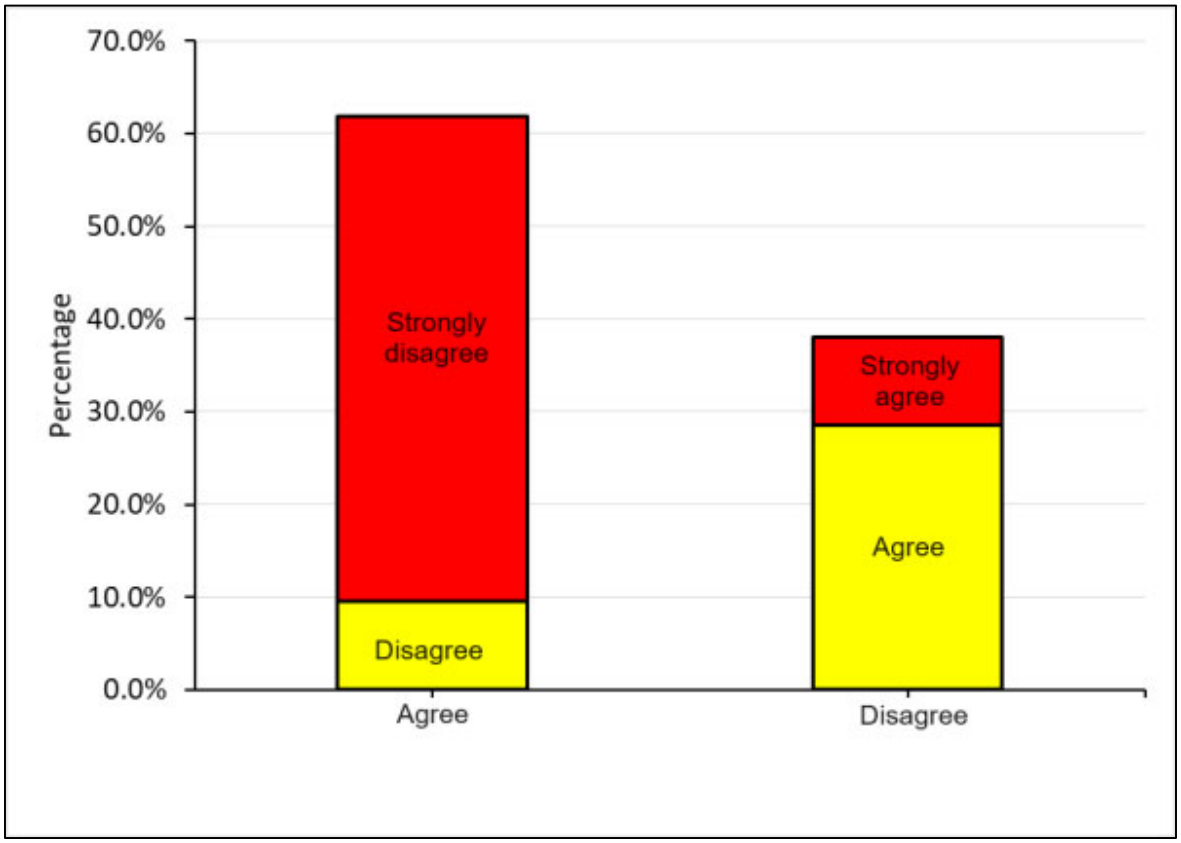

Figure 4.5: Level of agreement on lack of knowledge as a factor that contributes to improper solid waste disposal practices.

Table 4.3: Excerpts related to the results presented in Figure 4.5

Interview question 2
Explain whether, how and why level of knowledge impacts on your solid waste disposal practices?
Responses
R1: Lack of knowledge causes people to be less informed as to what they should do and what benefits their actions will bring. *R2: If you lack knowledge, you will never know where to throw the waste.* *R3: Knowledge can be coupled with ignorance so not only knowledge can make one to practice proper solid waste disposal.* *R4: It has helped to understand different types of solid waste disposal.*

Table 4.3 is a qualitative perspective on the statistics in Figure 4.5. In the qualitative reflections, respondents further explained whether, how and why they think level of knowledge contributes to solid waste disposal practices. Respondent 3 explained that sometimes people can have knowledge of proper solid waste disposal methods, but their ignorance can cause them to practice improper solid waste management.

4.3.3.2 Adequacy of solid waste disposal facilities

Most respondents (71%) agreed that the university does not have adequate solid waste disposal facilities, whilst 5% were neutral and 24% disagreed with the view that there are inadequate facilities. This contributes to improper solid waste disposal practices among university respondents. These findings are illustrated in Figure 4.6 below.

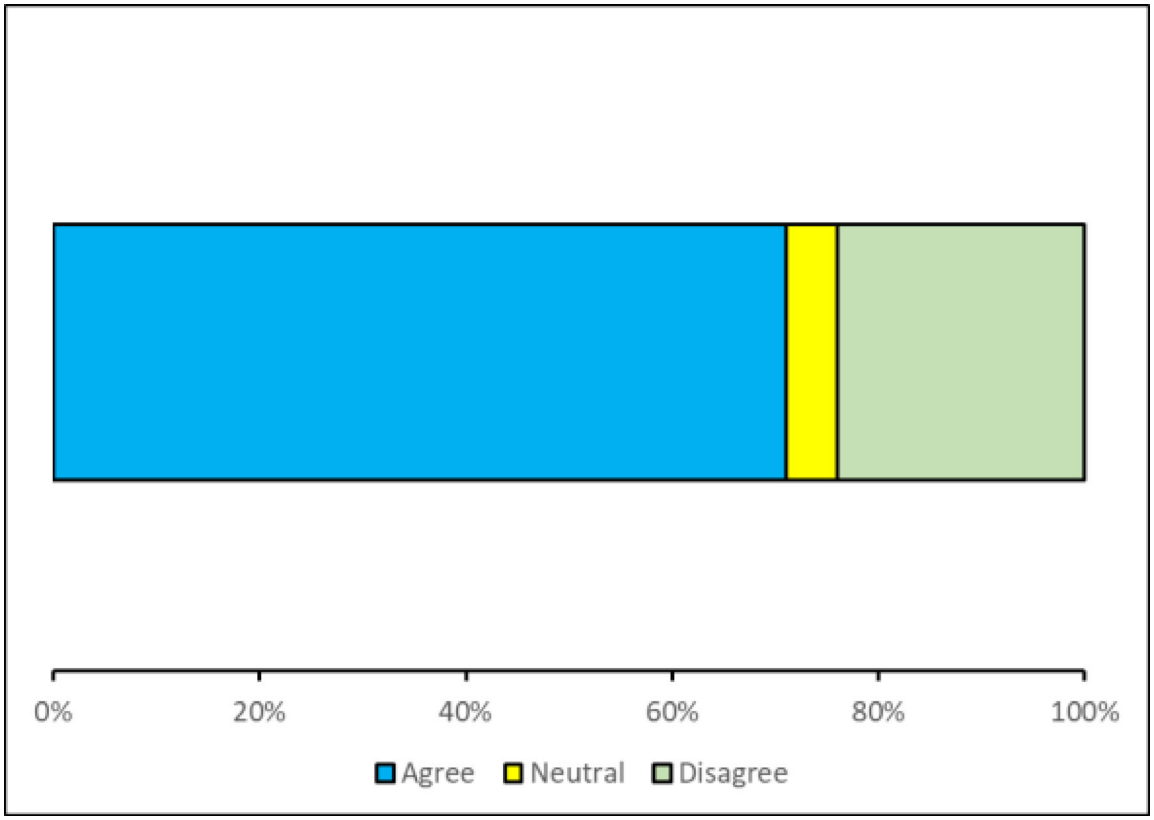

Figure 4.6: Respondents' level of agreement/disagreement on the availability of solid waste disposal infrastructure

Regarding a question related to the issue reflected in Figure 4.6, the researcher further asked the respondents to explain how and why the unavailability/availability of infrastructure such as bins contribute either to improper or proper solid waste disposal practices on the campus of the sampled university. The excerpts of responses are presented in Table 4.4 below.

Table 4.4: Availability of infrastructure for proper solid waste disposal

Interview question 7
Explain how and why the unavailability or availability of infrastructure such as bins contribute either to improper or proper solid waste disposal practices on campus.
Responses
R1: People dispose waste wherever and whenever they feel like and there's no way you can fault them because there's no bins. *R2: The unavailability of infrastructure can cause adverse impacts on campus. The campus loses its aesthetic value, health related issues may arise and lastly, it can yield to more improper solid waste activities*. *R3: From my perspective, it's quite clear that the university's solid waste disposal facilities are not up to standard. I often find that the bins are overflowing, which suggests that the university needs to invest more in proper waste management infrastructure.* *R4: I feel the current solid waste disposal facilities are inadequate. The lack of proper facilities often leads to improper waste disposal practices, which could be improved with better resources.*

4.3.3.3 Perceptions of how attitude impacts on solid waste management practices

Most respondents (90.50%) agreed that improper solid waste disposal practices are caused by attitude and behaviour towards solid waste management whilst 9.50% disagreed. This is evident in Figure 4.7 below as most respondents believe that indeed attitudes and behaviour contribute to the way people dispose of their solid waste.

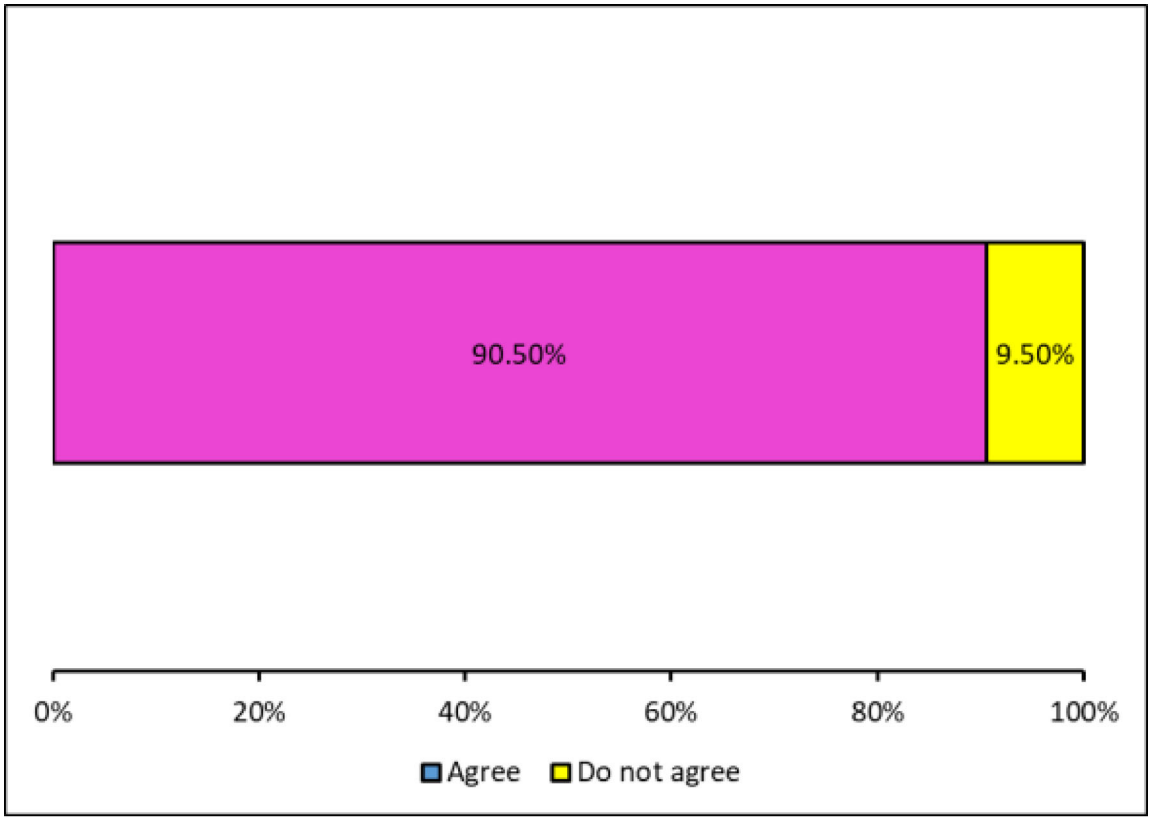

Figure 4.7: Respondents' response to whether attitudes contribute to improper waste disposal practices.

Table: 4.5: Below are the excerpts that support the findings in Figure 4.7.

Interview question 8	
Do attitudes contribute to improper waste disposal practices?	
Responses	
R1:	*In my opinion, the root cause of improper solid waste management lies in people's lack of awareness and irresponsible attitudes. Many individuals simply don't see the impact of their actions, like littering or not segregating waste, which leads to poor waste practices.*
R2:	*Attitude plays a huge role in how we handle waste. I've observed that when people don't feel personally responsible or don't see the immediate*

	consequences of their actions, they tend to neglect proper waste management practices.
R3:	*Behavioural habits are key here. If individuals aren't educated about the importance of recycling and waste segregation from an early age, they might not develop the right habits, leading to improper waste disposal and management.*
R4:	*I believe that our cultural attitudes towards waste significantly influence our practices. For instance, some people might view waste disposal as someone else's responsibility or might be indifferent to the environmental impact, resulting in improper waste management. What people do back at their homes they also do it on campus, meaning that solid waste disposal practices culture practiced at home they are also practiced at the selected institution. Due to the ineffective municipal solid waste management, we end up practicing improper solid waste disposal at home, a habit which is then carried forward to campus*.

4.3.4 Solutions proposed by respondents on how to properly dispose solid waste on campus

4.3.4.1 Awareness campaigns

Table 4.5 below captures suggestions on how to address causes of improper solid waste disposal practices as shown in Table 4.6 below. R1 for example said that environmental awareness campaigns should be rolled out regularly so to equip students with knowledge. R4 proposed posters around campus as a method that waste disposal education can be shared. R4, R3 and R1 emphasised the importance of word of mouth as suitable mode of environmental education campaigns.

Table 4.6: Excerpts that describe the need for awareness campaigns on campus to ensure proper solid waste disposal practices.

Interview question 3
Can you please explain what should be done to ensure that members of the Campus community are equipped with sufficient and appropriate knowledge to ensure proper solid waste disposal practices?
Responses
R1: Awareness, share information as to what they should do and why they should. *R2: Environmental awareness campaigns should be conducted on a quarterly basis. Students must be made aware that waste is wealth and must try to undertake waste management initiatives organized by the University.* *R3: Spread the word of mouth about solid waste disposal practices and put posters that prohibit the improper solid waste disposal.* *R4: Put posters on the walls showing places to keep solid waste"*

Most respondents (90.50%) confirmed that they were not aware of any solid waste campaigns around campus whilst a minority of 9.50% confirmed that they were aware of these campaigns. This is illustrated in Figure 4.8 below.

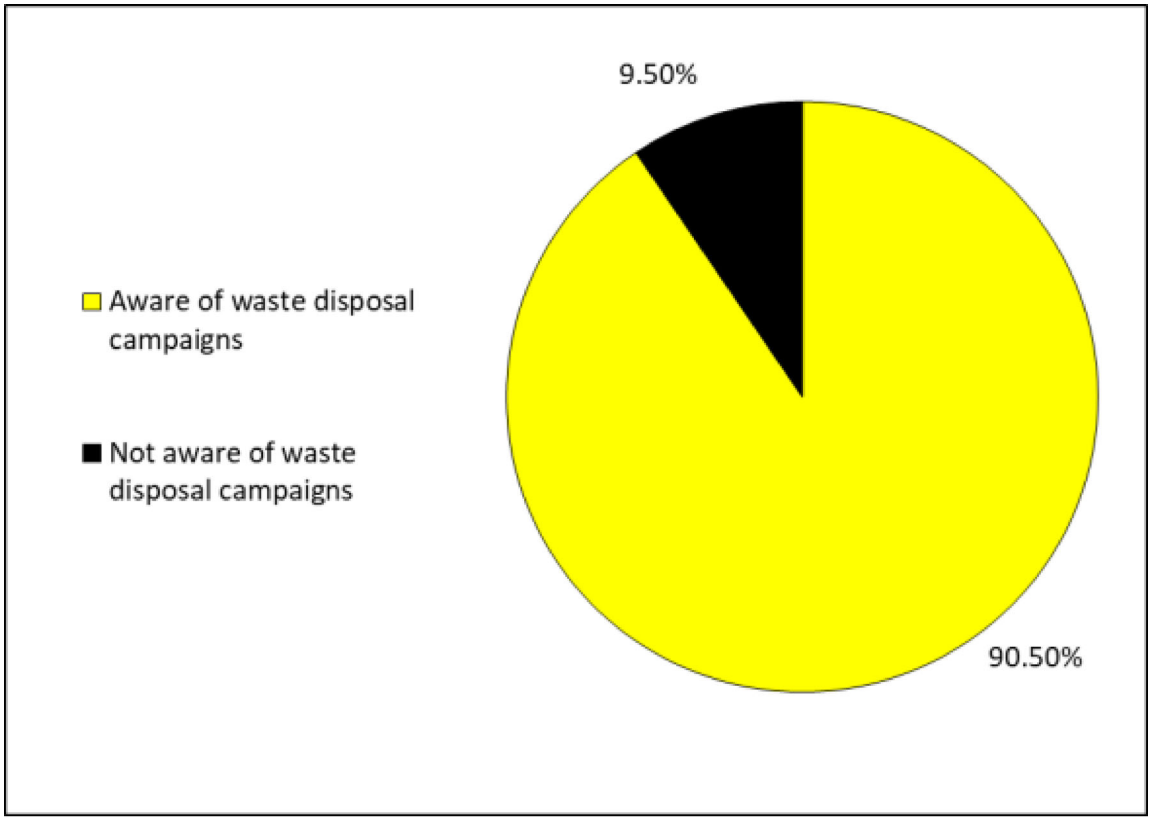

Figure 4.8: Awareness of respondents to solid waste disposal campaigns.

For the 9.5% minority, they were further requested to state the solid waste campaign programmes on campus.

Table 4.7: Excerpts that confirm solid waste disposal campaigns on campus.

Interview question 4
If you answered yes in figure 8 above, explain the kind of campaigns that are in place, whether and how the campaigns play a role in how you dispose of your waste?
Responses
R1 and R2: Green campus is the campaign that is on campus for solid waste management. *R3: They give knowledge and teaches us about how to keep the environment clean.*

As per respondents there is only one campaign around campus that speaks to proper solid waste management campaigns, and it is a green campus campaign. The campaign gives knowledge to the respondents that know how to keep the environment clean through practicing proper solid waste management practices. The interviewee further explained that the green campaign also has a competition of waste recycling and re-use in the selected university.

4.3.4.2 Positive attitudes towards proper waste disposal

Respondents were asked what could be done to change the behaviour and attitudes of the university community towards improper solid waste disposal. Results show that respondents believed that environmental education is one of the key elements to change behaviour and attitudes towards solid waste management. Such environmental education can be done through campaigns, imposing penalties or punishment for people who are not practicing proper solid waste management. Excerpts that support these are presented in Table 4.8 below.

Table 4.8: Excerpts that suggest solutions that can help change attitudes of the university community with regards to proper disposal of solid waste

Interview question 9
What do you think can be done to change the behaviour and attitude of people who are practicing improper solid waste disposal practices on campus
Responses
R1: Educating people about proper waste disposal, awareness. *R2: More campaigns should be put in place to educate fellow students about solid waste problem.* *R3: I think there should be punishment for people who are breaking the rule, by applying improper waste disposal The availability of infrastructure contributes to proper solid waste disposal practices on the campus.*

R4: it should be our daily topic.

4.3.4.3 Teaching waste disposal in all faculties

Most respondents (90.50%) confirmed that waste disposal as a module should be taught in every faculty at the selected university whilst a minority of 9.50% disagreed. This is illustrated in Figure 4.9 below.

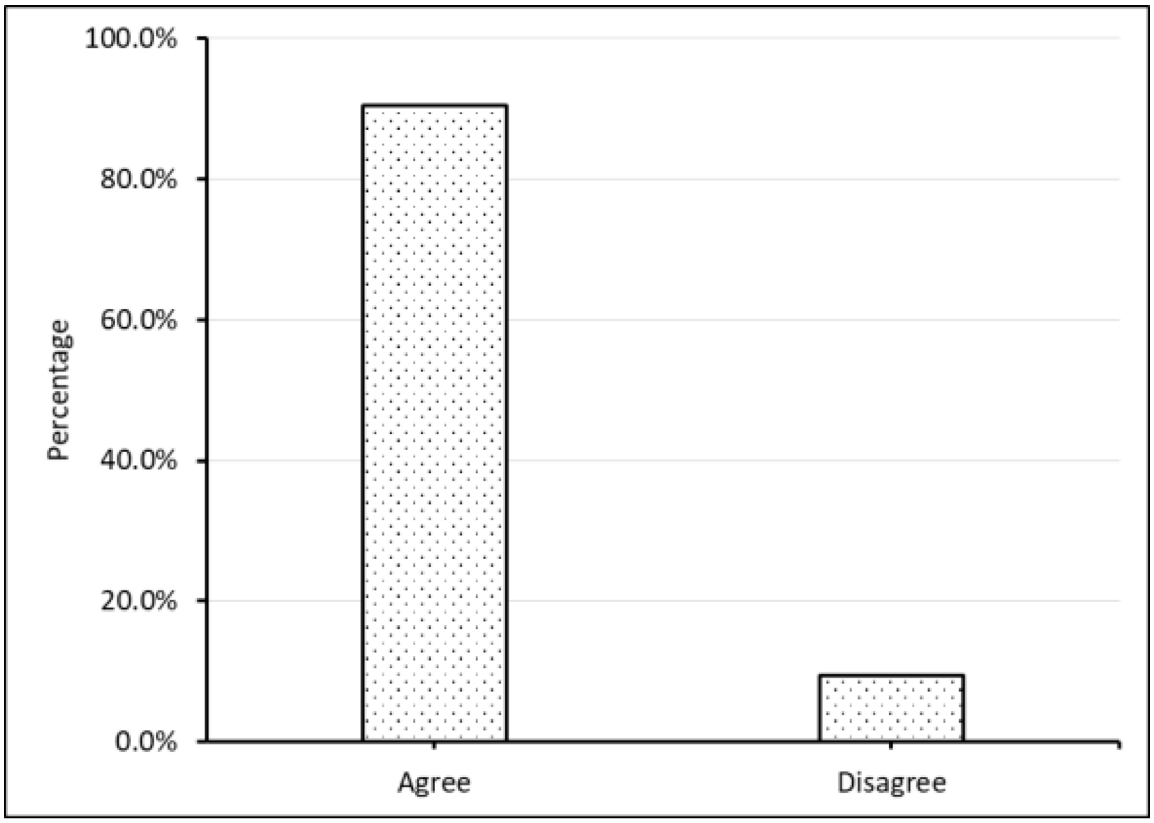

Figure 4.9: Suggestion on whether to include waste disposal as a module or not

The respondents were further requested to explain why solid waste management should be taught in all faculties. According to the respondents, solid waste management should be taught in all faculties for knowledge expansion and to keep the campus clean as the students taking up those courses would be equipped with knowledge that they will apply

to ensure the proper disposal of waste. The excerpts that support these findings are presented in Table 4.9 below.

Table 4.9: Excerpts that present why solid waste management should be taught in every faculty.

Interview question 6
Please explain why you think solid waste management should be taught in every faculty
Responses
R1: To keep the campus clean. *R2: For knowledge expansion* *R3: To make people understand the importance of clean environment.* *R4: Learning about solid waste management should be part of every faculty because it is directly related to many aspects of our daily lives. As a student, I see first-hand how critical it is to effectively manage solid waste. If everyone understands these principles, we can all contribute to more sustainable practices in our respective fields.* *R5: From a business perspective, understanding solid waste management can really impact how organisations operate. If all students, regardless of their faculty that they are registered under learn about waste management, it will prepare us to make more responsible business decisions and promote sustainability within our future workplaces.*

4.4 Discussion

4.4.1 Solid waste disposal practices of members of the university community

The study's results on how respondents handle solid waste disposal paint a nuanced picture of behaviour in waste management within an academic setting. A key finding in the study is that a significant sample surveyed admitted that solid waste is improperly disposed on campus. This reflects deeper insights into behavioural tendencies, the in/effectiveness of existing waste management strategies, and the broader implications for campus sustainability.

Research findings from this study suggest a noticeable division in respondents' perceptions regarding the effectiveness of solid waste disposal practices at the university, with 42% agreeing and 58% disagreeing that proper disposal is being achieved. This finding is indicative of significant concerns over waste management practices, aligning with previous research by Liao and Li (2019), Wondimu (2020), Nongo, Adejo and Ubagu (2021); Owojori, Mulaudzi and Edokpayi (2022) that highlighted poor waste disposal as a persistent issue on university campuses. The relatively high percentage of respondents who disagreed with proper disposal practices reflect a broader dissatisfaction with current waste disposal practices within the university. Further analysis by gender revealed a balanced distribution of responses. These findings, however, contradict with literature suggesting that gender can influence perceptions of waste disposal (Talalaj & Walery, 2015; Oztekin *et al*., 2017; Uma *et al*., 2020). According to these studies, women tend to exhibit greater environmental concern and are more likely to engage in waste-reduction activities (Echavarren, 2023). This may explain the slightly higher disagreement among female respondents, possibly reflecting a greater awareness of the shortcomings in the waste management systems of the university.

With respect to occupational groups, a considerable percentage of staff and students disagreed that the university community properly disposes solid waste. This shows that institutional affiliation may shape perspectives, as internal groups (staff and students) share similar inclinations, whereas external individuals, who may lack direct and frequent engagement with the university, hold distinct views. Such results corroborate with other

research findings such as Opaleye (2021), who found out that the university community disagreed that their university community in Nigeria properly disposes solid waste. Conversely, external individuals, had a different view as most agreed that the university community properly disposes solid waste. This mirrors findings in other higher education studies where external evaluations often diverge from internal perceptions (Laundon, Cunningham & Cathcart, 2023). However, this view by external individuals highlights a potential limitation in relying on their perceptions, as their interactions with the university may be based on limited observations, such as visiting on a single day when the university has been cleared of any solid waste, leading to a skewed positive assessment. Unlike staff and students, who engage with the university, almost on daily basis, and witness fluctuations in conditions, external visitors lack sustained exposure, possibly resulting in an overly favourable. This clearly aligns with the "*halo effect*" coined by Thorndike (1920), where a single positive attribute disproportionately shapes overall perception of an individual, suggesting that external evaluations may not fully capture the true operational dynamics of the sampled university.

4.4.2 Type of waste frequently disposed

Plastics, composing the largest part of the waste stream, are documented in environmental studies as a critical issue because of their durability and low recycling rates. These findings corroborate other findings from university campuses around the world (Mu *et al*., 2016; Nolasco *et al*., 2020; Baba-Nalikant *et al*., 2023; Fei *et al*., 2023; Sawalkar *et al*., 2023) reported on plastics being the most prevalent solid waste. The high percentage of plastics is a cause for concern to the environment and the authors suggest that improved recycling infrastructure and policies aimed at curbing plastic output and consumption, which would ensure extended producer responsibility and innovative technologies in waste sorting, are necessary. In addition to curbing plastic output and consumption, there is a need to improve waste disposal facilities in general and for plastic in particular.

Although paper waste is biodegradable, it nonetheless contributes to some of the important challenges of recycling and waste management. The large proportion of paper

within a waste stream reflects the need for improved waste segregation practices and increased adoption of digital alternatives that can help minimise paper consumption. Furthermore, food wastage is an environmental and economic issue. As reported by Bhatia et al. (2023), food waste makes a contribution to greenhouse gas emissions, and resources are lost in their production and distribution. Comprehensive strategies for managing food waste through composting and anaerobic digestion are necessary to reduce these impacts and turn waste into useful products (Bhatia et al., 2023).

Aluminium cans and glass bottles were also frequently mentioned in this study. These can also be recycled leading to considerable decreases in environmental impacts and consumption of resources (Farzadkia et al., 2021). More important is to enhance collection systems and consumer participation in increasing the rate of recycling, thereby reducing the waste disposal rate (Gibovic & Bikfalvi, 2021). Though electronic material has been found to account for a smaller fraction of the total waste, they require specialised management given hazardous components (Dev *et al*., 2020). Arya and Kumar (2020) emphasise developing advanced technologies for recycling and policies to tackle e-waste efficiently with the recovery of valuable materials and reduction of environmental risks.

4.4.3 Factors that contribute to improper solid waste disposal practices

Factors contributing to improper solid waste practices include inadequate knowledge, infrastructure, and attitudes towards waste disposal. Most respondents disagreed that lack of knowledge contributes to improper solid waste disposal. This response indicates that respondents do not consider knowledge gaps to be the lead cause of inappropriate practices. A minority of respondents feel however, that insufficient knowledge is a contributing factor, which again indicates a mixed perception about the need for educational awareness. Such divergence in the responses highlights the complex relationship between knowledge and waste disposal behaviour.

A number of studies (Dung, Mankilik & Ozoji, 2017; Mugisa & Omuna, 2024; Owojori *et al*., 2022; Wu, Zhu & Zhai, 2022; Yusuf & Fajri, 2022) however strongly attribute the improperly disposal of waste among the university community to lack of knowledge. This

assertion that improper waste disposal practices among the university community stems primarily from a lack of knowledge is unconvincing, given that universities are centres of intellectual excellence where the university community is presumed to be knowledgeable on the reparations of improperly disposing waste. Higher education institutions are well-known to actively promote sustainability in terms of proper waste disposal and environmental awareness (Fissi *et al*., 2021; Leal Filho *et al*., 2022). The university communities therefore should be at the forefront of proper waste disposal, and hence the reason why respondents argued that lack of knowledge contributes to improperly disposing waste.

Most respondents in this study instead, emphasised attitude as a contributing factor of improper disposal of waste. Many studies (Al-Rabaani & Al-Shuili, 2020; Esteban *et al*., 2020; Maphosa, 2021; Wu *et al*., 2022; Yusuf & Fajri, 2022; Qu *et al*., 2023) corroborate this finding. The university community may understand proper waste management but fail to act due to other factors that may include the absence of infrastructure and convenience. This aligns with behavioural theories (Razali et al., 2020) such as the Theory of Planned Behaviour coined by Ajzen (1991), which posits that attitudes, subjective norms, and perceived behavioural control, rather than knowledge alone, shape actions of individuals. How people perceive and react to waste management issues determines their disposal practices (Serge Kubanza & Simatele, 2019; Soares *et al*., 2020). Attitudes towards waste management will, therefore, include a set of beliefs and behaviours that encompass a sense of personal responsibility, perceived importance of proper disposal, and recognition of the environmental impact of waste (Soares *et al*., 2020; Olukanni *et al*., 2020). A lot of improper disposal practices occur when the personal priority and feelings of responsibility are not a big factor when handling waste (Hu & He, 2022; Chikowore, 2023). The university community, despite being aware of proper waste management, may exhibit negligence due to a general lack of personal responsibility. Therefore, it is necessary to implement behavioural interventions to change perceptions and habits about waste disposal, using approaches such as campaigns that highlight the implications of improper disposal on the environment and health as incentives for practising proper waste management.

A key factor shaping these attitudes is the adequacy of waste management infrastructure within the institution. This study revealed that the university campus does not have adequate solid waste disposal infrastructure. When waste disposal facilities are insufficient, individuals may develop negative perceptions toward proper waste management, leading to improper disposal practices (Mapotse, 2020; Debrah *et al*., 2021; Abubakar *et al.*, 2022). Several studies have also identified the lack of adequate solid waste disposal facilities as a causative factor for improper waste management on university campuses (Tangwanichagapong *et al.*, 2017; Bahçelioglu et al., 2020; Barlow & Drew, 2020; Ugwu et al., 2020; Dahlawi & El Sharkawy, 2021; Nolasco *et al*., 2021; Pulmo, 2023; Sawalkar et al., 2023; Njau *et al*., 2024). Inadequate solid waste disposal facilities can create frustration among the university community, reinforcing careless disposal habits. The fact that most respondents agree that the university lacks adequate facilities in solid waste disposal raises a key concern on the effectiveness of the institution's waste management infrastructure. This situation is particularly relevant in an academic environment where high volumes of waste are generated and where the presence of adequate facilities is crucial in maintaining cleanliness and promoting responsible waste management (Ugwu *et al*., 2020; Bahçelioğlu *et al*., 2020).

A smaller percentage of respondents however, indicated that there were adequate waste disposal facilities on campus, a perception that may stem from their limited exposure to certain well-maintained sections of the university. External individuals do not visit the campus frequently. When they visit, they usually are on business and frequent centralised facilities, such as administrative buildings and are more likely to report sufficient infrastructure, as these campus sections often receive priority in waste management services. Nonetheless, the availability, convenience and accessibility of waste bins, recycling stations, and collection services are critical in proper waste disposal on campus (Owojori *et al*., 2022). The fact that most respondents agreed that improper waste disposal practices are due to inadequate facilities underlines the need to invest and improvise waste management facilities (Shittu *et al*., 2020).

4.4.4 Proposed solutions to improper solid waste disposal on campus

There are various solutions to managing solid waste within a university setting, such as mounting an awareness campaign, inculcating positive attitudes about proper waste disposal, and applying the learning on waste disposal into everyday practice across all faculties. Each of these solutions is essential in developing an effective strategy that can ensure the feasibility of waste management over the long term.

Awareness campaigns may be instrumental in informing the community of the importance of proper waste disposal and its impact on the environment. The campaigns may follow various means, including posters, social media, workshops, and events. Various studies corroborate with awareness campaigns as a practical solution to properly dispose solid waste on campus (Tangwanichagapong *et al*., 2017; Olukanni *et al*., 2020; Debra *et al*., 2021; Jaglan *et al*., 2022). The key purpose of the awareness campaign would, therefore, be to enlighten the university community on proper ways of sorting and disposing of waste and the benefits that come with recycling and reducing waste. In this respect, the awareness is supposed to enlighten the understanding-action gap and drive people to better practices in waste management. Effective campaigns will involve clear and interesting messages and useful tips that clarify the common myths, followed by easy guidelines on the disposal of waste. Besides, frequent and updated campaigns may further solidify the message, thereby keeping it at a maximum level of awareness throughout the academic year. Awareness campaigns have the potential to reshape the attitudes of the university community toward proper solid waste management by fostering a deeper understanding of environmental consequences and personal responsibility.

Changing attitudes towards proper waste disposal is equally important (Soares *et al*., 2021). When people perceive waste management as a personal concern and understand the reasons why it is carried out, for example, to protect the environment and public health, they are most likely to engage in the right practices (Omotayo *et al*., 2020; Soares *et al*., 2021; Wut *et al*., 2021). This can be done through positive attitude inculcating programs, and this would include positive reinforcement of the correct waste management practices by either incentivising the same or, as an example, creating a

culture of sustainability by engaging and involving the students through various campus activities, including them in decision making on issues of waste management (Camarillo & Bellotindos, 2021). Activities such as sustainability fairs, competitions, or challenges can help foster a sense of community and shared responsibility, further encouraging proper waste management. Getting student organisations and leaders involved in the promotion of waste management adds to its effectiveness by exerting peer influence.

4.5 Summary

In this chapter, the study's findings were presented and discussed, considering respondents' views regarding im/proper solid waste disposal practices at a selected university in the Western Cape Province. Demographic details were first presented so that the reader understood the sample that the researcher worked with. Results from this chapter showed that a significant proportion of the respondents agreed that there is improper disposal on campus. There is a pressing need to take up better waste management strategies through improved educational programmes, infrastructure development, and community involvement in policy formulation. It also engages with some of the factors responsible for poor waste practices, such as gaps in knowledge, inadequate facilities, and attitude of the students. Most respondents did not consider lack of knowledge to be the primary cause of improper waste disposal. Inadequate infrastructure for the disposal of waste has been generally acknowledged as one of the significant problems that led to poor disposal of waste. Additionally, the chapter identifies the environmental impacts associated with various waste streams and points to a need for developing better recycling facilities and reduction strategies. Proposed solutions include awareness campaigns, ensuring that positive attitudes towards effective waste management are inculcated, and that waste disposal education is included within the curriculum. Such an approach would help close the knowledge-to-action gap, shift attitudes, and entrench waste management practices in university life, hence setting up a sustainable and effective waste management system. The final chapter of this thesis presents the conclusion and recommendations.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

Chapter 5: Conclusion and recommendations

5.1. Conclusion

This study addressed the critical research problem of improper solid waste disposal practices on a selected campus at a University in the Western Cape, South Africa. The primary aim was to evaluate im/proper solid waste disposal practices at the selected university and identify the underlying factors contributing to im/proper solid waste disposal practices. The key findings highlight a significant challenge of improper solid waste disposal practices, revealing that a majority of students and staff on the selected campus of the selected university engage in improper solid waste disposal practices. The study highlights the critical role of attitudes and education in fostering proper solid waste disposal behaviours, suggesting that enhanced awareness campaigns and the integration of solid waste management into academic curricula could effectively address these challenges. Furthermore, this research highlights the necessity for HEIs to adopt comprehensive solid waste management policies that align with national regulations and sustainability goals. Moreover, the findings encourage both students and staff to foster a culture of a healthy environment within the campus community, underscoring the need for comprehensive interventions that address infrastructural inadequacies and the underlying attitudes towards waste management, which are considered factors contributing to improper solid waste disposal practices. The study highlights the need for an urgent holistic approach of integrating education, improved facilities, and community engagement for fostering sustainable waste disposal practices within the studied area. Future research should focus on Higher Education Institutions' curricula, exploring how environmental issues are embedded in it and examining the development and implementation of Solid waste management policies as guided by the National Department of Environmental Affairs. In conclusion, the important issue of im/proper solid

waste disposal practices in higher education institutions (HEIs) is multifaceted, requiring immediate and sustained attention.

5.2 Recommendations

The study recommends enhancing the physical infrastructure for waste disposal which includes increasing the number of clearly labelled bins for recycling, composting, and general waste throughout campus. Besides placing the bins and other resources, regular maintenance of the bins is necessary to prevent overflow and contamination. The institutional commitment to a cleaner and healthier higher education institution should extend to allocating funding for educational initiatives and recycling programmes. The Department of Environmental Affairs should ensure that in higher education institutions, regulations governing solid waste management are effectively implemented and the Safety, Health and Environment departments of higher education institutions have policies and procedures of proper solid waste management practices so that the allocated funds for solid waste management practices are utilised effectively.

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