Waste management behaviour: a case study of school children in Mpumalanga, South Africa

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ABSTRACT

This study examined the level of awareness, knowledge and practices of primary and secondary schools students with regard to waste management. Only a limited number of studies were found to evaluate school student's awareness, knowledge and practice of waste management in South Africa. Literature was reviewed dealing with waste management awareness, knowledge and practices of school students and discussed at the hand of the principles, objectives and targets of the South African Government towards waste and waste management.

Using a structured, self-administered questionnaire, a total of 815 students were surveyed from four primary schools and three secondary schools from the Embalenhle and Secunda area Govan Mbeki Municipality, Mpumalanga South Africa. The data were analysed by the use of descriptive statistics including frequency count, percentage, mean and standard deviation. Other analyses employed included two-way frequency tables with Pearson Chi-square test, Phi coefficient, in order to determine the significant relationship between students' socio-demographic variables.

The study showed that the students were obviously aware of concerns with waste and waste management practices in their schools and local environment. It was also apparent the school students had an acute awareness that poor waste management would have a negative impact on the country as well as on them as the individual. This prominent awareness was however not evident in the students' waste management practices. Good waste management practices activities were minimal at both the school and home environment. Since school students are seen as one of the key agent of change to work towards a more sustainable future, they should be engaged as young as possible and given a quality array of continuous learning to improve their knowledge on environmental problems such as poor waste management. Improved knowledge would contribute to improved environmental awareness and a pro-environmental attitude. The critical recommendations of the study are that the South African Government will have to intensify the research to better understand the needs of children to environmental matters such as waste management.

Key words: waste management, awareness, knowledge, understanding, practices, school students, Mpumalanga, South Africa.

OPSOMMING

Hierdie studie ondersoek die vlak van bewustheid, kennis en praktyke van primêre en sekondêre skool studente met betrekking tot afvalbestuur. Slegs 'n beperkte aantal studies is gevind oor skool studente se bewustheid, kennis en praktyk van afvalbestuur in Suid-Afrika. Daar is ‘n literatuurstudie gedoen met betrekking tot afvalbestuur bewustheid, kennis en praktyke van die skool studente aan die hand van die beginsels , doelwitte en teikens van die Suid-Afrikaanse regering teenoor afval en afvalbestuur.

Met behulp van 'n gestruktureerde, self-geadministreerde vraelys, is 'n totaal van 815 studente ondervra by vier primêre skole en drie sekondêre skole uit die Embalenhle en Secunda area Govan Mbeki Munisipaliteit, Mpumalanga Suid-Afrika. Die data is ontleed deur die gebruik van beskrywende statistiek insluitend frekwensie tabelle, persentasies, gemiddelde en standaardafwykings. Daar is ook ingesluit tweerigting- frekwensietabelle met Pearson Chi -square toets en die Phi -koëffisiënt , om ten einde die beduidende verband tussen die studente se sosio- demografiese veranderlikes te bepaal.

Die studie het getoon dat die studente bewus en bekommerd was oor afval en afvalbestuur in hul skole en plaaslike omgewing. Dit was ook duidelik dat die skool studente 'n akute bewustheid gehad het en besef het dat swak bestuur van afval 'n negatiewe impak op die land sowel as op hulle as die individu het. Hierdie prominente bewustheid was egter nie duidelik in die studente se gedrag van persoonlike afvalbestuur nie. Goeie afvalbestuur aktiwiteite was minimaal in beide die skool en die studente se tuistes. Aangesien die skool studente beskou word as een van die belangrikste agente van verandering om 'n meer volhoubare toekoms te verseker, moet hulle so jonk as moontlik by afvalbestuur betrek word. Die studente moet 'n gehalte verskeidenheid opleiding ontvang om hul kennis oor die omgewings probleme soos swak afvalbestuur te verbeter. Kwaliteit kennis sal bydra tot verbeterde omgewingsbewustheid en 'n beter aanvoeling vir die natuur en betreklike probleme. Die kritieke aanbevelings van die studie is dat die Suid-Afrikaanse regering die navorsing na die behoeftes van kinders tot omgewings- kwessies soos afvalbestuur beter verstaan om so doende meer effektiewe oplossings te bewerkstellig.

Sleutel Woorde: afvalbestuur, bewustheid, kennis, begrip, praktyke, skool studente, Mpumalanga, Suid-Afrika

DECLARATION

I declare that this dissertation, apart from the contributions mentioned in the acknowledgements, is my own unaided work. It is submitted for the degree of Master of Environmental Management at the North West University, Potchefstroom Campus. I also declare that it has not been submitted before to this institution for another degree or any other institution in this country or abroad.

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Signature of the Candidate

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Date

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List of Acronyms

DEAT – Department of Environmental Affairs and Tourism

ECA – Environmental Conservation Act

IBM SPSS (Statistical Package for Social Sciences) – IBM Predictive Statistical Software

IMEP - Integrated Metropolitan Environmental Policy

IPWM - Integrated Pollution and Waste Management

JSTOR – Journal Storage

NEMA – National Environmental Management Act

NEM AQA - National Environmental Management: Air Quality Act

NEMWA – National Environmental Management: Waste Act

NWMS – National Waste Management Strategy (NWMS)

SAWIC – South African Waste Information Centre

SEMA - Specific Environmental Management Act

UN – United Nations

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1 Chapter 1: Introduction

A number of different wastes are generated either directly or indirectly through human activity on earth. Waste can be present in a number of forms including food waste, electronic waste, solid waste, hazardous waste, special waste and domestic waste. Waste disposal and management of waste were not familiar problems in the 18th and early 19th century. This can be ascribed to the low numbers of the human population, low growth rate in the human population and relatively slow technological advancement at the time. The world population started growing significantly in the 1950's, together with this increased growth waste disposal and the management thereof began to constitute serious problems to humans and to the global environmental systems. These environmental problems appeared in the form global warming, decaying of natural life, ozone layer depletion and extinction of plant and animal species (Mert, 2006).

The management of waste has become one of the key environmental concerns of the past decades, with hundreds of scientific papers published on the topic every year. An increase in published papers on waste management was already highlighted by discussions held at the World Summit on Sustainable Development (DEAT, 2005:1). A search on the keywords "*Waste Management*" delivered published peer reviewed articles in excess of 13 500 on Science Direct; Teacher Reference Centre; JSTOR; Environment Complete; Academic Search Premier; Google; Google Scholar and EBSCO host for the period 1980 to 2013. The management of waste attracts increasing attention all over the world as people are becoming conscious of a variety of environmental problems such as global warming, air, water and land pollution. Waste generated as part of daily human activities not only damages natural resources, but the potential negative impacts on the environment or human health cannot be excluded (Zurbrügg 2003; United Nations 2010).

Therefore the management of waste has become one of the most significant problems for man to deal with and to mitigate the negative impacts on global environmental systems. This has led to the adoption of the waste hierarchy principle that addresses waste issues using the principles of waste reduction, waste reuse and waste recycling. Buchanan (2005) also supports the concept that waste is solely a function of overwhelming population increase and technological advancements: "*In nature, there is no waste. In the organic cycle, the waste from one creature or process is nourishment for the next. Today, we not only consume or destroy nature's resources faster than they can be regenerated, but we give nothing back to nature. Instead, we further burden it with waste and toxic pollution"* (Buchanan, 2005, 32).

In 1994 the end of apartheid in South Africa heralded a new parliament, Constitution and Bill of rights. These significant changes lead to the integration of South Africa back into the world economy, taking its place as a low to medium income country. South Africa is ranked 121st as a developing country by the World Bank and International Monetary Fund (International Monetary Fund's World Economic Outlook Report, April 2012.) Developing countries face a number of regulatory pressures from developed countries in the world and to be a successful competitor a developing country must overcome such regulatory pressures effectively. Environmental regulation is an example of such regulatory pressures and to operate as a globally responsible country is therefore critical to the success of South Africa in the current world economy.

With the increase in economic development comes the increase in commercial, industrial, hazardous, mining, power generation and radioactive waste, all of which have to be regulated and managed. Since 1994 the South African Government has recognized the need for the management of waste and it has been prioritized as a key issue of environmental management. Government emphasizes that waste needs to be managed according to the following fundamental environmental management principles - accountability; affordability; cradle to grave management; polluter pays; equity; sustainable development; integration; open information; subsidiary; waste avoidance and minimization; co-operative governance; and environmental protection and justice (DEAT, 2005:1).

The Constitution of South Africa (Act 108 of 1996, Section 152(1)) and the White Paper on Integrated Pollution and Waste Management (Republic of South Africa, 1996, 2000) recognizes the role of the government in ensuring a safe and healthy environment for all South Africans. Although the provision of waste management services, waste disposal management, and the promotion of a safe and healthy environment are strongly promoted by the South African Government, Nahman and Godfrey (2010) point out that there are a number of key issues on waste and waste management in South Africa. These issues have not only had significant economic and social impacts, but have also resulted in serious environmental degradation. Government made a joint declaration in September 2001 that was delivered with specific aims to implement a waste management system that contributes to sustainable development and safeguarding livelihoods, by harnessing the energy and commitment of citizens to waste reduction. This joint declaration also proposed the reduction of waste generation and disposal of 50% and 25% respectively by 2015 as well as developing a plan for zero waste by 2022. Further reference was made to reiterate a commitment to the Integrated Pollution and Waste Management (IPWM) Policy, the National

Waste Management Strategy (NWMS) and the principles of waste minimization, reuse and recycling for sustainable development (DEAT, 2000; 2011).

However, environmental problems such as waste management cannot only be solved at government level but need to be addressed at the individual level, which is the focus of this section. Al-Rabaani and Al-Mekhlafi, (2009) recommend that individuals will have to develop the awareness, gain knowledge and implement practice which will guide them to more environmentally supportive behaviour. Bartlett (2002) describes young people's capacities as active agents in identifying problems in their surroundings. Researchers also argued over the years that school students are knowledgeable about their local area and acutely susceptible to negative and positive changes (Malone, 1999; Duan and Fortner, 2005). Furthermore, researchers see youth as being able to both identify issues that concern them and propose new ones of their own. It can therefore be further argued that children are amongst the key enablers toward sustainable waste management worldwide and in South Africa. However in order to positively influence the views and mind-set of youth toward sustainable waste management, it is important to understand the preconceptions, ideas, knowledge and beliefs of school students in South Africa about environmental issues.

Further literature searches was done for a number of the key phrases[1] within the databases of Science Direct; Teacher Reference Centre; JSTOR; Environment Complete; Academic Search Premier; Google; Google Scholar and EBSCO host for the period 2000 to 2013. A number of international studies have however been conducted to assess the knowledge and practices of school students towards environmental problems, including Madanay and Bugahoos p69 (1998); Srbinovski *et al* (2011); Yurttas and Sülüna (2010); Ifegbesan (2010); Desa *et al* (2010); Tomažiča and Vidic (2011). Most of these studies concluded that there is a wide variation in awareness, knowledge and practices among students depending on socio demographic variables such as age, gender ethnicity, socio economic and upbringing.

In South Africa one such key socio-demographic variable is the difference between school students' awareness, knowledge and practice in the townships and cities of South Africa. There are also significant social and economic differences these differences are still remnants of the rulings made by the South African Government during the apartheid regime. Only two studies have been found which assessed some aspects of school students' awareness, knowledge and practices towards environmental waste aspects in South Africa,

[1]: *School students/students and waste management in South Africa/international; School students/students waste management awareness South Africa/International; School students/student waste management knowledge South Africa/International; and School students waste management practices South Africa/International*

i.e. Hens *et al* (2010) and Peden (2008). The study from Hens was more focused on the implementation of environmental management systems in the primary schools in South Africa while Peden highlighted the current knowledge and required education in schools to promote sustainable development in South Africa. Neither one of the authors addresses waste behaviour issues specifically. This gap in information therefore poses the research questions to be addressed in this paper, i.e. what is the state of awareness, knowledge and practice regarding waste amongst school students in South Africa. The aim will be to evaluate some of the preconceptions, ideas, and beliefs of a sample of grade 7 and grade 11 students in a township and city school environment, Mpumalanga South Africa, by gauging their awareness, knowledge and practices of waste management.

The research of this study will be positioned around students' awareness, knowledge and practices of waste management in four primary and three secondary schools in Mpumalanga South Africa. The research will specifically try to establish a baseline of descriptive information on students' behaviour (awareness, knowledge and practices) with regards to waste and waste management in South Africa and in their local environment (township or city).

1.1 Study aim and objectives

It was indicated in the section above that there was studies in the last two decades on socio-demographic variables and the perception of waste and waste management by school students. They have attempted to predict environmental awareness and attitudes of people based on their socio-demographic characteristics, but did not address the combination of awareness, knowledge and practice. They also did not include the South African socio-demographic variables of students living in townships and the cities. The aim of this study is therefore to investigate and understand school students' views on waste and waste management in South Africa and their local environment.

The goal of this research study is approached by means of three objectives:

Objective 1: To review relevant literature dealing with waste management awareness, knowledge and practices of school students.

Objective 2: To discuss the principles, objectives and targets of the South African Government towards waste and waste management.

Objective 3: To describe and critically evaluate the data collected on the behaviour (awareness, knowledge and practices) of a sample of primary – and secondary school students in Mpumalanga, South Africa.

Therefore, besides the literature study on principles, objectives and targets of waste management in South Africa and waste management awareness, knowledge and practices of school students, the main methodology for this study includes a questionnaire that was designed to evaluate school students' behaviour (awareness, knowledge and practices) of current waste management practices in primary and secondary schools in Mpumalanga, South Africa. The data from the questionnaires were captured and edited to enable further statistical analysis. These objectives also aim to highlight and provide insight on what a current group of primary and secondary school students know and consider about waste management and practices. The information resulting from this study could be valuable to understand the youth's perception on waste management in their local environment, which in turn could help to identify potential solutions to positively influence the views and mind-set of youth and to achieve national and international goals for sustainable development. In order to facilitate ease of reference and order of results with research objectives, the table below summarises and links the methodology, study objectives and the chapter layout of the dissertation (Table 1.1).

Table 1.1: Research objectives, methodology and dissertation layout

Research Objectives	Research Method	Dissertation Chapter
Set the research scenario	Literature Study	Chapter 1
Objective 1: To review relevant literature dealing with waste management awareness, knowledge and practices of school students.	Literature Study	Chapter 2
Objective 2: To discuss the principles, objectives and targets of the South African Government towards waste and waste management.	Literature Study	Chapter 2
Objective 3: To describe and critically evaluate the data collected on the behaviour (awareness, knowledge and practices) of a sample of primary – and secondary school students in Mpumalanga.	Administration of questionnaire at selected schools in Mpumalanga South Africa. Results and Deductions from collected data	Chapter 3 Chapter 4
Synthesis	Write – up and supporting literature	Chapter 5

2 Chapter 2: Literature Study

2.1 Introduction

This chapter starts by taking a broad overview of literature on the sustainable development of local and international waste management before addressing the first and second research objectives of this study. The first objective will be dealing with waste management awareness, knowledge and practices of school students. The chapter reviews relevant literature before it continues to evaluate on the potential role of school students in addressing environmental problems. This is followed by a review of literature to address the second objective of discussing the principles, objectives and targets of the South African Government towards waste and waste management, but also elucidating the legal mandate and basis of waste management in South Africa, the South African constitution, National Environmental Management: Waste Act (NEMWA) and National Environmental Management Act (NEMA). This section is focused on the South African legal mandate specifically the role of school students. The chapter concludes with a summary and commentary on published literature related to the potential contribution of school students to effective waste management and how they are seen as the future adults, equipping them with a correct and solid foundation for effective waste management and sustainable development.

2.2 Sustainable development and waste management

The management of waste has become one of the most significant problems for mankind in this day and age. The industrialization of the planet by mankind has resulted in the production of waste volumes that are now growing to such an extent that it negatively impacts on the planet's environmental systems (Buchanan 2005). The generation of these volumes of waste cannot continue indefinitely as it results in the total destruction of environmental systems that would also negatively impact on the survival of the human race. It is from this risk to the environment that the concept of sustainable development was shaped.

According to the book published by the United Nations in 1987 "Our Common Future: Report of the World Commission on Environment and Development" the definition for sustainable development was first released in 1987 by the United Nations in the famous Brundtland Report,1987, p 27, which included what, is now one of the most widely recognized definitions: *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."*

According to the same report, the above definition contains within it two key concepts:

- *"the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and*
- *the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs."*

Munslow and Fitzgerald (1994) already stated that working towards sustainable development in South Africa would have significant challenges, some of the most pronounced challenges are that South Africa has one of the largest income inequalities of any country in the world, overcrowding of the population in the townships and weighty dependence on the export of non-renewable minerals. These challenges are still prevalent today and directly impact on the effective application of the concept of sustainable development in South Africa.

A crucial contradiction throughout the world and also in South Africa, is the economic growth models of development and environmental health, they stand in fundamental opposition (De Gruchy,2001; Stevenson, 2006;) together with insufficient global resources which will prevent developing economies from following the same path as industrialized nations (Webster, 2004).

The concept of sustainable development is rooted in a systems approach of thinking; to recognize and successfully fulfill this concept the human race will need to do introspection; understand the environment and the number of serious complex problems associated with effectively managing nature and its resources. As highlighted in the section above waste management is one of the complex problems mankind will have to understand in more detail together with introspective evaluation on how mankind will realize sustainable development.

Historically, the focus of waste management was a cleansing function only. This includes waste storage, collection, transport and disposal. The management of waste in this way upholds and protects public health and quality of life, by removing the waste from the living and working areas. The removal of waste was seen as the fundamental core of basic waste management (Brown and Fraser, 2006; Wilson, 2007; UN Habitat, 2010). Waste removal and disposal is however only a short term solution and can never be seen as the sole or ultimate solution to waste management. Once the fundamental removal of waste is in place to uphold and protect public health the focus can shift towards promoting sustainability with regard to waste management. Appropriate solutions based on integrated waste

management principles can then be considered. These solutions could potentially include the waste hierarchy of preferred options namely: Waste avoidance; reduction of waste at source; Resource recovery; Re-use; Recycling; Treatment and only as a final option disposal. These solutions are not easy to achieve and will require a radical mind shift in society. However the quest for zero waste and achieving sustainable waste management can be realized through the processes of awareness; education (knowledge) and the actual practice thereof.

Environmental awareness has gone from strength to strength in South Africa during the past two decades, not only in the government, but also to some degree the awareness of the general South African public. It is this awareness on the individual level which can develop into attitudes that will guide countries to sustainable development solutions for environmental problems such as waste management (Ahmed and Mohammed Al-Mekhlafi, 2009, pp.9). They further state that *"individuals are constantly adopting and modifying attitudes to fit their ever changing needs and interest. Attitude cannot simply be changed by education. Acceptance of new attitude depends on who is presenting the knowledge, how it is presented, how the person is perceived, the credibility of the communicator, and the conditions by which the knowledge was received. Research in social sciences has shown that knowledge on a topic may increase; people may even change attitudes, but that the step to improved behaviours and practices is depending on a complex set of social and psychological factors".* (pp. 9).

However Curzon, (2003) and Johnston, (2010), state that desired behaviours and attitudes that are rewarded and reinforced are likely to be repeated and, ultimately, incorporated into an individual's personal value set and routine behaviour. It helps develop people's awareness, knowledge and attitudes and enables them to be effectively involved in sustainable development (Palmer, 1998). These desired behaviours and attitudes towards sustainable development are known as pro-environmental behaviour and refer to behaviour that harms the environment as little as possible, or even benefits the environment (Geller, 2002). The theory of the possibilities of forming pro-environmental behaviour through education of school students has also been proposed by Jensen and Schnack (1997) & Kollmuss and Agyeman (2002). The section to follow will expand on this idea of the role children could play in addressing environmental problems and working towards sustainable development practically with regards to waste.

2.3 The potential role of school students in addressing environmental problems

There are various opinions on the role of school students in sustainable development, but in most cases, they are identified as agents of change; future custodians of the planet; future decision-makers; developers and managers of society's institutions and the environment. (Chawla, 1988; Evans and Gill , 1996; Clugston, 2000; Fielding 2004, Percy-Smith & Thomas 2010). Vaselinoska, *et al* (2010) states that the positive relationships of children to nature together with their individual range of emotions have special influence on the behavior of children to nature and the power thereof should not be underestimated. The World Organization for Early Childhood Education, Engdahl and Rabusicova (2010) reported how children, from all over the world, describe the earth and sustainable development with a deep sense of empathy. The report concluded that there is potential value in the children's voices and that their inputs should be considered for sustainable development (Engdahl and Rabusicova, 2010). This notion is supported and the concepts children understand with regards to sustainable development could be a source of valuable knowledge that can be used to develop teaching methods as well as guidelines to empower the children as world citizens and agents of change.

The development of the children into responsible future citizens has become a recent topic of interest. International reports on the importance of education of young students towards sustainable development have been emphasized by the European Panel on Sustainable development (2010). The panel also encourages early childhood institutions to already engage with the issue of sustainable development with children from a very young age. Vaselinoska, (2010) also highlighted that the development of negative long term consequences is a reality if children are not allowed the opportunity to form a relationship with the natural environment. This could in turn lead children to feel that environmental issues and concern are alien subjects to them and may even behave negatively towards the environment. It is further argued that, awareness, knowledge and positive practice towards the environment should be instilled at the early stage of human development because anything that children perceived in the earlier life will more readily influence their behavior and attitudes of their later life.

Palmberg and Kuru (2000) directed from their research that environmental knowledge and emotional attitudes were found to be important factors for taking environmental responsibility. Therefore it is seen as important to understand the current awareness and practices of school students to be able to empower children in understanding the requirements for sustainable waste management and to enable them to lead the change.

The effective management of waste is prevalent in all sustainable development objectives across the world. The effective management of waste or the lack thereof, can have detrimental implications for the health of the environment, economy and society (Dias, 2006). Therefore achieving sustainable development will require effective waste management strategies and behavioural change, whether individually or collectively. The question can then be asked why sustainable development is so important to today's children. This question can be answered by simply understanding that the children's lives today and their lives in the years to follow and that of future generations will be affected by the impacts of climate change and environmental degradation. As indicated in the sections above today's children are also the decision-makers of the future, and those decisions will be based on their awareness, knowledge and practice acquired during their childhoods. Therefore the children have an active role to play now in our efforts to effectively manage waste and work towards a sustainable future.

The following section will expand on the research that has been conducted internationally and in South Africa on understanding waste management awareness, knowledge and practices of school students.

2.4 Waste management awareness, knowledge and practices of school children

The past two decades have delivered a number of studies throughout the world that were conducted on combinations of the awareness, knowledge and practices of school students with regards to waste management (Hausbeck, 1992); Schulze, 1993; Madanay and Bugahoos, 1998; Ifgbesan, 2010; Desa *et al* 2010; Tomažič and Vidic, 2011; Tayci *et al* 2012). No studies could however be found in international and South African literature where the combination of awareness, knowledge and practices of school children with regards to waste management was studied. The following subsections will discuss the literature found in each of the aspects: awareness, knowledge and practice and the relation to waste management.

2.4.1 Awareness and waste management

Awareness is the state or ability to perceive, to feel, or to be conscious of events, objects, or sensory patterns. In this level of consciousness, sense data can be confirmed by an observer without necessarily implying an understanding (Oxford Dictionary, 2013). Education and awareness are often crucial and a key part of any country's waste management strategy. This is also the case for South Africa's Integrated waste management strategy (NWMS; 2010) under the National Environmental Management Waste Act (Act 59, 2008).

Desa *et al* (2010, pp. 643-648) state that *"Components of environmental awareness can be classified into two aspects: perception and behaviour, that is, the perception of environmental problems and the behavioral inclination to protect the environment. The perception of environmental problems involves people's objective knowledge, perception and environmental realities".* A number of studies propose that environmental education is an integral part of raising environmental awareness in children and that children should be educated in a way that would raise their environmental awareness and improve their knowledge so that they could make informed and responsible decisions as adults (Zelezny and Schultz; 2000; Fernández-Manzanal, 2007, Littledyke, 2008).

From the International literature there is strong evidence which suggests that awareness and attitudes towards waste generation and management are critical to support the human race's endeavor to address the current waste management challenge. Literature on the environmental awareness of children is not abundant in the case of South African studies. Literature is limited to knowledge and education studies as was done by Schulze (1993) and; Peden (2008) Schulze's (1993) study suggests that students do not seem to have adequate basic knowledge about the environment. The study found the development of environmental literacy in students, issues such as ecology, population, pollution, culture and natural resources should be addressed more pertinently in the school curriculum. Peden (2008) set out a book to provide a set of introductory readings for South African students of environmental education at tertiary level. The book serves to highlight a number of issues around the state of environmental education in South Africa. It is also indicated that the environmental curriculum in schools needs to be revaluated to ensure a quality environmental education to children to increase knowledge and awareness.

2.4.2 Knowledge and waste management

According to the Oxford dictionary the definition of knowledge is: *"knowledge is a familiarity with someone or something, which can include facts, information, descriptions, or skills acquired through experience or education. It can refer to the theoretical or practical understanding of a subject. It can be implicit (as with practical skill or expertise) or explicit (as with the theoretical understanding of a subject); it can be more or less formal or systematic"* (Oxford Dictionary, 2013).

Knowledge with regards to a specific subject is intimately linked to some form of education in that subject. Education has been recognized to possess the capability to meet these challenges through promoting awareness and knowledge on various environmental issues,

changing the attitudes of people, generating critical thinking, actions and working towards achieving sustainable development. Education should also aim to increase public awareness about environmental problems and their solutions (Barraza *et. al*., 2003) by providing required skills and knowledge (Ballantyne *et .al*., 2006).

However attitude cannot be changed by simple education. Desa *et al* (2010, 643-648) stated that: *"Acceptance of new attitude depends on who is presenting the knowledge, how it is presented, how the person is perceived, the credibility of the communicator, and the conditions by which the knowledge was received."* Research in social sciences has also shown that knowledge on a selected topic may increase; people may even change attitudes, but that the step to improved behaviours and practice depends on a complex set of social and psychological factors (Desa *et al* 2010)

Chanda (1999) reported that people's environmental knowledge is highly specific to issue and geographic scale and this was supported through research done by Ifegbesan (2010). Shulze (1993) adds that *one* of the reasons for poor decision making in environmental issues is a lack of basic environmental knowledge.

Knowledge can therefore be seen as a critical component, in determining a person's understanding of environmental issues and therefore environmental awareness that leads to practice. Research by Caduto (1983) found that up to 40 percent of people's environmental activity could be explained in terms of their knowledge. However there are a number of studies that indicate that although a person's awareness and behaviour is directly impacted and affected by knowledge their commitment and sound environmental practice remains the responsibility of the individual and their attitude towards the environment (Dunlap 1994; Inglehart, 1995). Based on the results of the literature sited it is vital to assess and understand the students' knowledge to enable a more accurate understanding of responses towards awareness and practice as is evaluated in this study.

2.4.3 Practice and waste management

Practice is the actual application or use of an idea, belief, or method as opposed to theories about such application or use (Oxford Dictionary, 2013). In an ideal world all people on earth should demonstrate high levels of good practices and responsibility regarding environmental matters including waste management. The literature in sections 2.4.1 (Awareness) and 2.4.2 (Knowledge) highlighted that research has shown that awareness and knowledge on environmental matters may increase, people may even change attitudes, but that the critical steps to improve behaviour and practice are dependent on a complex set of social and

psychological factors. It is however imperative to translate all knowledge, awareness and attitude into practice, because without effective practice actual results will not materialize in the solving of complex and integrated problems such as waste management (Desa *et al*, 2010; Ifegbesan, 2010; Al-Khatib *et al*, 2010; Gebril *et al*, 2010). Therefore there must be a constant drive to encourage and promote awareness through education towards effective waste management and sustainable environmental practices.

Studies have shown that school students in general have poor waste management practices all over the world and a number of papers have investigated the link between poor waste management practice and aspects such as awareness, attitude and knowledge (Madanay and Bugahoos, 1998; Jensen, 2002; Ehrampoush and Maghadam, 2005; Ssenyondo *et al* 2008; Desa *et al* 2010). In most cases these studies found direct correlations between poor waste management practices and a lack of environmental knowledge and awareness. They also highlighted that a more active and focussed approach is required to put all the philosophy from environmental studies into good practice towards sustainable development. If word is not put to deed all research efforts will be pointless and poor waste management will be a consistent problem of the future human race.

This focussed approach to turn philosophy from environmental studies into good practice towards sustainable development is also critical for South Africa. However to enable this focussed approach the significant gap in lack of research studies on the understanding of school students awareness, knowledge and practice of waste management in South Africa will have to be closed. South Africa will have to embrace the contribution of the countries youth in the effort of achieving sustainable development. Fundamentals in the understanding of children's awareness, knowledge and practice in waste management can contribute to improved waste management, improved education and evidently to a more sustainable future.

2.5 Legal mandate/basis of waste management in South Africa

During the past two decades, South Africa has made significant strides in addressing key issues, requirements and problems experienced in waste management. The Constitution of South Africa, (Act 108 of 1996) provides the foundation for environmental regulation and policy in South Africa. The right to environmental protection and to live in an environment that is not harmful to health or well-being is set out in the Bill of Rights (section 24 of Chapter 2).

"Everyone has the right:

(a) to an environment that is not harmful to their health or well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that -

(i) prevent pollution and ecological degradation;

(ii) promote conservation; and

(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."

Prior to 1998 the Environmental Conservation Act (ECA) (Act 73 of 1989) was the only piece of legislation that addressed waste issues such as littering, permitting of waste disposal sites and regulatory competency. This was followed in 1998 by the Draft White Paper on Integrated Pollution and Waste Management for South Africa. The White Paper advocated a shift from the focus on waste disposal and impact control to a more integrated approach to waste management and prevention as well as minimisation. In terms of legal changes this has entailed national government drafting and promulgating legislation requiring the prevention and minimisation of waste.

2.5.1 Legislation governing waste in South Africa

- The South African Constitution (Act 108 of 1996)

  The Constitution is the highest source of law in South Africa. The Constitution is relevant to this study in two regards. Firstly, it contains an environmental right as well as certain administrative rights, which provides a mandate for waste management regulation. Secondly, it also provides the regulatory mandate for the protection of everyone's right to have an environment that is not harmful to his or her health. Therefore the Constitution accordingly sets the broad framework for environmental governance and protection.

Waste in South Africa is currently governed by means of a number of pieces of legislation, including (South African Waste Information Centre SAWIC, 2013):

- The South African Constitution (Act 108 of 1996)
- Hazardous Substances Act (Act 5 of 1973)

- Health Act (Act 63 of 1977)
- Environment Conservation Act (Act 73 of 1989)
- Occupational Health and Safety Act (Act 85 of 1993)
- National Water Act (Act 36 of 1998)
- The National Environmental Management Act (Act 107 of 1998)
- Municipal Structures Act (Act 117 of 1998)
- Municipal Systems Act (Act 32 of 2000)
- Mineral and Petroleum Resources Development Act (Act 28 of 2002)
- NEM: Air Quality Act (Act 39 of 2004)
- National Environmental Management: Waste Act, 2008 (Act 59 of 2008)

Legislation related to waste management in South Africa is further discussed in the sections below.

· Hazardous Substances Act (Act 15 of 1973)

The Hazardous Substances Act is directed by the Minister of Health and provides for the control of substances that may cause injury, ill-health or death to human beings by reason of the substance being toxic, corrosive, irritant, strongly sensitising, and flammable or a pressure vessel. The primary purpose of the Hazardous Substances Act is not to regulate waste management; however it contains regulatory powers with regards to the correct disposal and management of hazardous substances.

· Health Act (Act 63 of 1977)

The National Health Act is aimed at establishing a framework for the management of health services. The Act does not directly reference waste or the management of medical waste but it does refer to waste indirectly through municipal health services which include waste management and the provisions setting out the powers of the Minister to make regulations in respect of medical waste.

· Environment Conservation Act (Act 73 of 1989)

The Environment Conservation Act is recognised as one of the most important Acts governing waste in South Africa. The most important regulatory aspect from the Act is that it makes provision for the regulation of waste with the set aim of providing protection to the environment. Large sections of the Environmental Conservation Act have been repealed by NEMA but the sections regulating waste are still in effect.

· Occupational Health and Safety Act (Act 85 of 1993)

The Occupational Health and Safety Act is the primary law regulating health and safety matters. It regulates all job sectors with the exception of mining and merchant shipping. The Act does not make direct provision for or reference to waste management, but specific regulations have been passed in terms of the Act. One such regulation is the hazardous biological agent regulation.

- National Water Act (Act 36 of 1998)

  The National Water Act contains comprehensive provisions and regulation for the protection, use, development, conservation, management and control of South Africa's water resources. The Act is the principal legal instrument to effectively manage water resources in South Africa. The National Water Act does not directly address waste management, but does however indirectly regulates and address the impact poor waste management will have on the water resources of the country.

- The National Environmental Management Act (Act 107 of 1998)

  In relation to waste management, the National Environmental Management Act (Act 107 of 1998) (NEMA) was promulgated to give legislative effect to the provisions of the White Paper on the National Environmental Policy. The Act was established from the principles of a stronger statement of the waste management hierarchy that promoted avoidance of waste as the most basic objective of waste management. The Act is seen as an enabling umbrella Act that provides for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment.

- Municipal Structures Act (Act 117 of 1998)

  This Municipal structures Act provides for the establishment of municipalities and defines the various types and categories of a municipality. It also regulates the internal systems, structures and office-bearers of municipalities and provides for appropriate electoral systems. The Act does not directly address waste management but a number of functions exercised and performed by the municipalities have a significant impact on waste management through provision of services and service delivery agreement. Failure in these aspects of the Act will negatively impact good waste management practice.

- Municipal Systems Act (Act 32 of 2000)

  The Municipal Systems Act aim to provide for the core principles, mechanisms and processes that is required enabling municipalities to progressively work towards social and economic upliftment of local communities, and ensure universal access to essential services. The Act does not directly address waste management but a number of functions exercised and performed by the municipalities have a significant impact on waste management through provision of services and service delivery agreement. Failure in these aspects of the Act will negatively impact good waste management practice.

- Mineral and Petroleum Resources Development Act (Act 28 of 2002)

  The Mineral and Petroleum Resources Development Act contains comprehensive provisions for equitable access to and sustainable development of the South Africa's mineral and petroleum resources. The reference to waste management in the Act is aimed at the responsible and effective management of any debris, discard, tailings, slimes, screening, slurry, waste rock, foundry sand, beneficiation mineral, processing plant waste, ash or any other product derived from mining operations.

- National Environmental Management: Air Quality Act (Act 39 of 2004)

  The National Environment Management: Air Quality Act (NEM AQA) must be interpreted and applied in accordance with the principle specified in the NEMA. The purpose of the Act is to set norms and standards for Institutional frameworks, roles and responsibilities on air quality management planning air quality monitoring; air quality management measures and then general compliance and enforcement. The relationship between NEMWA and NEM AQA is that the NEM AQA can be seen as the protection, restoration and enhancement of air quality in South Africa where NEMWA aims to achieve the same for other waste types set out in the Act.

- National Environmental Management: Waste Act, 2008 (Act 59 of 2008)

  In an attempt to address the current fragmentation in waste legislation in South Africa and to develop a holistic and integrated approach to waste management, the President of the Republic of South Africa signed The National Environmental Management: Waste Bill into an Act of Parliament in March 2008. The Act took effect from 01 July 2009. The Waste Act is called a Specific Environmental Management Act (SEMA) under NEMA. This means that NEMA applies to this Act and the principles which are outlined in section 2 of NEMA is also applicable.

The Act gives the Minister of Environmental Affairs the power to develop and publish a National Waste Management Strategy (NWMS) for implementation. The NWMS is a legal and procedural document which outlines the priorities of the country in terms of ensuring that waste is minimised and effectively managed. The strategy aims to set targets for waste reduction based on the principles of the waste hierarchy.

The objectives of the Act are:

"(a) to protect health, well-being and the environment by providing reasonable measures for:

(i) minimising the consumption of natural resources;

(ii) avoiding and minimising the generation of waste;

(iii) reducing, re-using, recycling and recovering waste;

(iv) treating and safely disposing of waste as a last resort;

(v) preventing pollution and ecological degradation;

(vi) securing ecologically sustainable development while promoting justifiable economic and social development;

(vii) promoting and ensuring the effective delivery of waste services;

(viii) remediating land where contamination presents, or may present, a significant risk of harm to health or the environment; and

(ix) achieving integrated waste management reporting and planning;

(b) to ensure that people are aware of the impact of waste on their health, well-being and the environment;

(c) to provide for compliance with the measures set out in paragraph (a) and

(d) generally, to give effect to section 24 of the Constitution in order to secure an environment that is not harmful to health and well-being." (Government of South Africa, 2008).

It is clear the from the South African waste legislation framework discussed above that there is significant fragmentation that need to be addressed by the South African Government. Legislative fragmentation is not conducive to sustainable environmental and governance efforts (Kotze, 2006).

Kotze, (2006) further states that Fragmentation can be attributed to *inter alia* historical developments such as apartheid and that a developing country such as South Africa also inherited fragmented and uncoordinated legislation that was not focused on sustainable development. It is then also proposed that fragmentation should be addressed as a matter of priority on all environmental legislation in South Africa.

Fragmentation is a complex problem and not easy to solve, however possible solutions to overcome the problems generated by legislative fragmentation could be to reduce the fragmentation or to use tools such as quality education (Awareness and Knowledge). Quality education could lead to a better understanding of the fragmented legal framework and how to address the problems generated more effectively. Educating children and young adults in environmental problems such as fragmentation of the legislative framework could have positive spin-offs for waste management, environmental management and sustainable development as a whole.

2.6 Role of Children in Waste Management

Children or young adults are often instrumental in bringing about change in society. Research through the years has shown that among children and their parents, the children can be effective advocates in changing their parents' lifestyles and this process create a positive or negative influence with regards to environmental matters (Kiev Declaration, 2003; Ballantyne *et al* , 2006; Lui and Kaplan; 2006; Rickenson and Lundholm; 2008). In the real world, however, children are often not included in the critical decisions that are made in their communities where they live. This was also found to be the case in the review of the South African legislative mandate in waste management. There is little reference to children or the youth as a direct protagonist of effective waste management in South Africa. Although education advocacy and awareness is implied in the IWMS strategy it is only stated in a broad manner and the direct inclusion and the active role children can play is not addressed. (NWMS, 2010:118). The Integrated Metropolitan Environmental Policy of Cape Town (IMEP) (IMEP, 2001) provides a further strategic basis for Environmental Awareness, Education and Training Strategy. IMEP envisions a city in which there "will be a positive relationship between local government and civil society, Environmental Awareness, Education and Training Strategies to ensure people will be environmentally educated, aware and conscious. Also to support education that enhances the understanding of the environment, while promoting an ethic of collective responsibility of the environment amongst all citizens.

As part of the sustainable development goals the only objective that generally includes the address of children as part of the solution towards effective waste management is the section where it is stated that people need to be made aware of the impact of waste on their heath, well-being and the environment. This objective can be linked directly to education which in turn is generally focused on students in primary school, secondary school and tertiary institutions. The question that should be asked is: are these broad objectives enough to place explicit focus on the role that young people can play in shaping a vision and a

promise towards effective waste management? By taking children's ideas more seriously government and adults can begin to realize the extent of their possibilities (Bartlett, 2002).

2.7 Conclusion

This chapter examined a wide range of literature in order to achieve the first and second objectives of this study; i.e., to review relevant literature dealing with waste management awareness, knowledge and practices of school students and to discuss the principles, objectives and targets of the South African Government towards waste and waste management. These are all important aspects that need serious consideration to ensure a sustainable future. The chapter highlighted that sustainable development is rooted in a systems approach of thinking and that of individuals with special focus on the role of children. Children's understanding with regards to addressing environmental problems and sustainable development is broadly discussed and how they are seen as a source of valuable knowledge that can be used to develop appropriate guidelines and teaching methods to empower the children as world citizens and agents of change.

The next chapter examines the methods used as part of the study to evaluate the awareness, knowledge and practices of grade 7 and grade 11 school students in Mpumalanga, South Africa. The chapter provides the design of the questionnaire; the collection of data; management of the data; the statistical analysis and geographical information of the study area.

3 Chapter 3 : Methods of Study

3.1 Introduction

In line with the third objective of this study, this chapter presents the methodology of the study to describe and critically evaluate the behaviour (awareness, knowledge and practices) of a sample of primary and secondary school students in Mpumalanga, South Africa. A questionnaire based approach was the selected research method to collect data from the school students, because questionnaires are practical, cost effective, large amounts of information can be collected from large number of individuals, results can easily be quantified and results can easily be analysed (Popper, 1959). While it is true that questionnaires also have drawbacks such as being unable to evaluate feelings, emotions or behaviour; truthfulness of respondents; thought process of respondent and researcher imposition, a questionnaire approach was still identified as the most fitting research instrument for this study (Popper, 1959). The chapter will not only highlight the design of the questionnaire, but will also supply detail on the geographical setting of the study, collection of data and finally the approach to data analysis.

3.2 Design of Questionnaire

Based on the reviewed literature as was discussed in Chapter 2, a questionnaire was designed to determine school students' behaviour (awareness, knowledge and practices) on waste management in primary and secondary schools in Mpumalanga, South Africa. Grade 7 students were identified as the ideal grade to evaluate as the most senior students in the primary schools. Grade 12's was identified as the preferred grade for evaluation in the secondary schools, also being the most senior. Surveying the grade 12's was however not possible since the survey would have interfered with the students exams. Grade 11 students were then identified as the second preferred option to complete the survey. The questionnaire was structured into three main sections namely awareness, knowledge and practice. Each section had the purpose of collecting information from school students to achieve usable data that would give an overview of the current state of understanding on waste management in the South Africa as well as the students' local environment.

A short description of the questionnaire is set out in Table 3.1 and an example of the questionnaire that was completed by the students can be viewed in Appendix I. The introductory section of the questionnaire collected socio-demographic information of the student: School, Grade, Age, Gender, Language and Ethnicity. This was followed by an example on how questions will typically be asked and that only one answer per question will

be valid. This example was also described verbally to the students before the actual completion of the questionnaire.

Table 3.1: The target information and details of the waste management behaviour questionnaire (Appendix I)

Section	*Target Information*	*Question numbers*
Introductory Section	Socio-Demographic information	First Table
Section 1 : Awareness	Section aimed to assess the awareness of school students on waste and waste management in their schools and in South Africa.	Questions 1a – 16a (pages 1 – 4)
Section 2 : Knowledge	Section aimed to assess the waste and waste management general knowledge of the school students.	Questions 1k – 14k (pages 5 – 6)
Section 3 : Practice	Section aimed to assess the waste management practices school students at their schools and home environment.	Questions 1p – 8p (pages 7 - 8)
Section 4: Attitude	Data from all question groups that delivered qualitative information across all questions	Question 11a (page 4) ; Question 5p and 6p (page 7)

The first section of the questionnaire consisted of 16 questions using a combination of a three to five point Likert scale. The section aimed to assess data on the awareness of waste management in the students' school as well as in South Africa. There were 16 questions asked in this section (Table 3.1). In retrospect the awareness section of the questionnaire was over ambitious and statistical analysis proved that only 6 questions from this section delivered value adding quantitative data. Selected questions did deliver qualitative data which was also used as part of this study.

The second section was aimed at evaluating the knowledge component of the students about waste management and consisted of 14 questions (Table 3.1) which had a number of multiple choice questions. The knowledge section had only one correct answer option per question asked. Knowledge questions were formulated based on literature and the principles of key waste volumes, concerns and activities in South Africa (Misra and Pandey, 2005; Adler *et al* 2006; Karani and Jewasikiewitz, 2007). The knowledge questions were simple and were aimed to be associated with the expected grade 7 knowledge base. The final four questions from the knowledge section was omitted as part of the data and statistical because of large numbers of incomplete answers for this section.

The third and final section, practices and behaviours, consisted of eight questions based on a 5 - point Likert scale. The practice and behaviour section had 8 questions (Table 3.1) that aimed to highlight other potential useful facets such as students' willingness to persuade friends that waste management is important to protect the environment, what type of means do they use most to obtain waste management information and whether they would actually contribute some of their own money towards waste management.

The questionnaire was designed and validated with the assistance of expert**s** from school of Environmental Sciences and the School of Statistics consultation services of the North West University, Potchefstroom Campus, South Africa. The questionnaire was randomly pilot tested with 23 primary and secondary school students selected from schools that did not participate in the questionnaire surveys. The data collected from these 23 students were not used as part of the data in this thesis. Minor corrections such as spelling mistakes and word order were made to the questionnaire before the approved questionnaire was printed on paper format for completion by students.

3.3 Data collection and Geography

This study was approved for ethics and consent by the health research ethics committee North West University. The school principals of all the seven identified schools were contacted for permission to survey students at the schools.The questionnaires were shared with the principals and teachers for approval weeks before the survey was to be completed. Specific date and time appointments were made for the completion of the questionnaires by the students. The questionnaire was administered class-wise due to the numbers of students that participated in the questionnaire. A total of 815 students were surveyed from four primary schools and three secondary schools from the Embalenhle and Secunda area Govan Mbeki Municipality, Mpumalanga South Africa (See figure 3.1 for geographic location). A primary and secondary school from a township area (Embalenhle) were selected and five schools (three primary, two secondary) from the urban area (Secunda). The 815 questionnaires were all collected on the day of completion, of which only 717 of the questionnaires were properly completed and could be used as part of the data set and analysis. This amounted to a fairly good (87.9%) return of questionnaires.

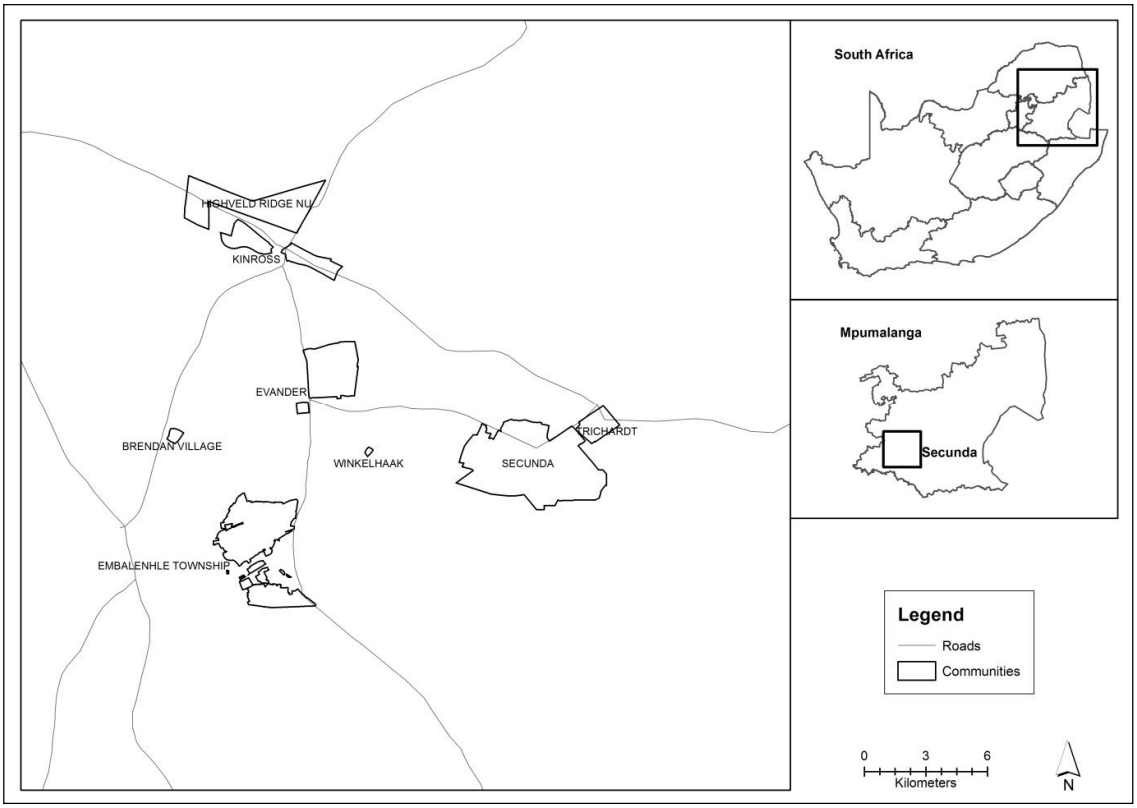


Figure 3.1: Map of Study region (Secunda & Embahlenle Township, Mpumalanga, South Africa)

The sample (n= 717) was evenly balanced with 362 (50.5%) grade 7 students and 355 (49.5%) grade 11 students. The sample was also evenly balanced in gender with 344 (48%) male and 373 (52%) female students. The sample was slightly skewed with regards to ethnicity: Blacks 459 (64%), Whites 210 (29.3%), Indians 25 (3.5%), Coloured 19 (2.6%) and Asian 4 (0.6%). The skewed ethnicity was however in-line with the general South African demographics. The sample was split evenly between students from a large township and the urban area (48.2 % and 51.8% respectively). The minimum and maximum ages for the primary school students were 12 years and 18 years respectively with an average age of 13.26 years. The minimum and maximum age for the secondary school students were 15 years and 23 years respectively with an average age of 17.51 years. A small percentage of the students in grade 7 and grade 11 groups were older than the average students in the respective grades. These individuals are actually young adults already and could skew the data, however these individuals were in low insignificant numbers and the data was not excluded from the data set. It is known that in the poorer township and impoverished areas in South Africa children attend schools at an age significantly higher than the norm for a specific grade. The average age can be exceeded due to poor pass rate of an individual or late start of school due to difficult personal circumstances.

The collected data from the questionnaires were captured on Microsoft Excel spreadsheets and arranged to enable further data and statistical analysis. Numerical values were assigned to each question and potential answers for each questions to serve as grouping variables for the statistics (example: Awareness Question 1 had 5 options on the Likert scale. Numbering for the question was Q1a and each option had a numerical 1 – 5 numbering). Each data point could only be indicated as a positive (1) or negative (0) on the spreadsheet. This approach was taken to assist with statistical analysis using computer software (Statistica and IBM SPSS).

3.4 Data Analysis

The data were analysed by the use of descriptive statistics including frequency count, percentage, mean and standard deviation. Other analyses employed included two-way frequency tables with Pearson Chi-square test, Phi coefficient, in order to determine the significant relationship between students' socio-demographic variables and the evaluated awareness, knowledge and practices of waste management. Measure of Association was used to calculate the strength of association between variables and for ordinal variables the direction of the relationship between two variables was also determined. Phi Coefficient was also used to measure the strength of the association between variables (e.g. Male vs. Female). Pearson Chi Square results were only seen as significant when the measure of association was Phi > 0.2 (See Table 3.1) (Steyn, 2002; Ellis and Steyn, 2003).

A principal component factor analysis categorized the data from the 16 awareness questions into 2 groupings namely: questions 1a, 4a and 13a *"the student's awareness and concern with waste generated South Africa and in their local environment"* and questions 3a, 15a and 16a *"the students perceived impact of waste and waste management on the country and themselves"* (Table 3.2). Only the data from these data groupings were discussed further as part of the study.

The knowledge section of the questionnaire consisted of 14 questions of which the last 4 questions were omitted due to insufficient completion by students. The data from the knowledge section of the questionnaire aimed to evaluate the students' knowledge on general waste related questions. The knowledge questions were interpreted as either correctly answered or incorrectly answered. Statistical analysis for practical relationships between variables was done, but no significant results were found and data were therefore described qualitatively (Table 3.2).

Table 3.2: Statistically grouped questions extracted from the waste management behaviour questionnaire (Appendix xx)

Section	*Question numbers*	*Statistically grouped questions*	*Questions group description*
Section 1 : Awareness	Questions 1a – 16a (pages 1 – 4)	Questions 1a; 4a; and 13a.	The students' concerns with waste generated in South Africa and their local environment
		Questions 3a; 15a; and 16a.	The students' perceived impact of poor waste management on South Africa and on themselves
Section 2 : Knowledge	Questions 1k – 14k (pages 5 – 6)	Questions 1 – 10k	One correct answer per knowledge question
Section 3 : Practice	Questions 1p – 8p (pages 7 - 8)	Questions 3p and 5p	The students' familiarity and involvement in waste practices at school
		Questions 4p and 8p	The students' familiarity and involvement in waste practices at home
Section 4: Attitude	Question 11a (page 4) ; Question 5p and 6p (page 7)	Question 11a; Question 5p and 6p	Data from all question groups that delivered qualitative information across all questions

The final section of the questionnaire was to evaluate the practice of the school students to determine whether they were active in waste management, or have a desire to be more active in waste management. Statistics by measure of association categorised the data from the 8 practice questions into 2 groupings namely: questions 3p and 5p *"the students' Familiarity and involvement in waste management practices at School"* and questions 4p and 8p *"the students' familiarity and involvement in waste management practices at home"* (Table 3.2). Only the data from these data groupings were discussed further as part of the study.

Only data that delivered significant results for the Pearson Chi-square test were tabulated and graphed in the manuscript and data that were significant for Cramer's Phi measure of

association were discussed in further depth. It was important to understand the practical significance and relationship between two variables, e.g. between gender and preference for waste recycling. For random samples, the statistically significance of such relationships are determined with Chi-square tests, but actually one wants to know whether the relationship is large enough to be important. In this case the effect size is given by $w = \sqrt{\frac{X^2}{n}}$, where X^2 is the usual Chi-square statistic for the contingency table and n is the sample size; see Steyn, 2002. In the special case of a 2×2 table, the effect size (w) is given by the phi (ϕ) coefficient. Note that the effect size is again independent of sample size. Cohen (1988) gives the following guidelines for the interpretation of it in the current case:

(a) small effect: $w = 0.1$, (b) medium effect: $w = 0.3$, (c) large effect: $w = 0.5$

Attitude was not directly addressed in the ambit of this study but awareness, knowledge and practice are all linked into and combined into the attitude of a specific individual. It was found in this study that some questions answered by the students did not deliver results with significant differences between the socio demographic variables, but still revealed useful aspects about the views and attitudes of the students towards waste management. A section was added to qualitatively describe the answers to three additional questions, Question 11 from the awareness section and Questions 5 and 6 from the practice section (Table 3.2). These aspects were also further graphically illustrated and discussed.

3.5 Conclusion

This chapter gave a detailed description of the design, approval and administering of the research questionnaire that was used to collect data on the behaviour (awareness, knowledge and practices) of a sample of primary – and secondary school students. The chapter continued with a description of the geographical location of the schools accessed for the study. It further elaborated on the collection of data for the study as well as the theory on how the data were analysed. The interpretation of the results is presented in the next chapter where significant and relevant results are unpacked and discussed.

4 Chapter 4: Results

4.1 Introduction

The previous chapter gave an overview of the development of the questionnaire that was used to obtain waste related information from grade 7 and grade 11 school students in Mpumalanga, South Africa. The students were questioned to determine their awareness, knowledge and practice with regards to waste and waste management in South Africa and their local environment, and the chapter also expanded on the analytical and statistical methods utilised to make sense of all the data collected.

In this chapter the data collected for the three key sections (awareness; knowledge and practice) are presented, analysed and discussed. The aim of the chapter is to distil well-defined outcomes for discussion and interpretation. Data that delivered significant results between socio demographic variables are graphed, tabulated and discussed while all results from the study are available in Appendix II. The last section of this chapter briefly highlights the results that did not deliver statistical significant differences between the socio demographic attributes, but still revealed interesting aspects about the views and attitudes of the students towards waste management.

4.2 Awareness of waste and waste management

Environmental awareness can be classified into two aspects:

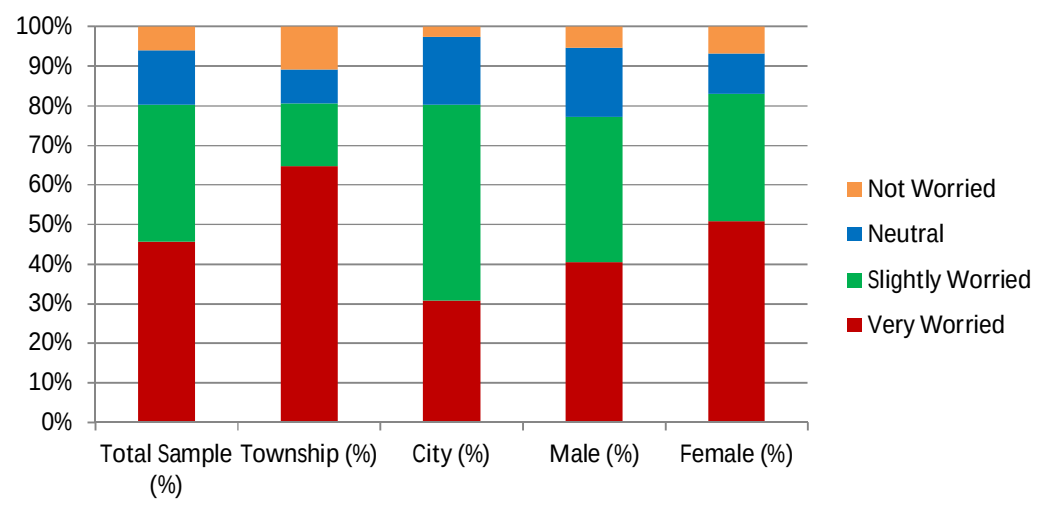
- The perception of environmental problems and
- The behavioural inclination to protect the environment or understand how problems could impact on the individual or humanity should the environment not be protected.

This awareness of environmental problems involves people's objective knowledge, perception and environmental realities with regard to a specific environmental problem such as waste management in their country or local environment, as was the case for this study. As highlighted in Chapter 2 there is strong evidence to suggest that individual or group awareness and attitudes towards waste generation and management are critical in the effort to respond to the waste management challenge. Therefore the first three questions that will be discussed in this section aim to highlight the students' awareness of and concern with waste generated in South Africa and in their local environment. The second set of questions aims to deal with how the students' perceived good or poor waste management and the impact it would have on them in their local environment.

Table 4.1: School students concerns around waste volumes generated in South Africa

Q1a. To what extent are you worried about the volumes of waste generated in South Africa?

	Very Worried	Slightly Worried	Neutral	Not Worried
Total Sample (%)	45.6	34.7	13.6	6.1
Township (%)	64.7	15.9	8.7	10.7
City (%)	30.8	49.4	17.3	2.5
Male (%)	40.4	36.9	17.4	5.3
Female (%)	50.4	32.	10.0	6.8



	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.426✻
Male vs. Female	P < 0.05♀	0.13 ◊

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice.

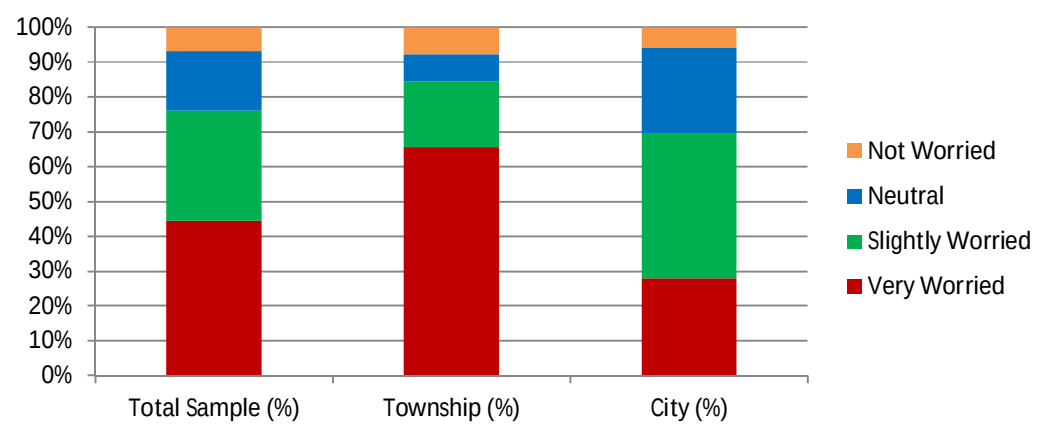
4.2.1 Students' concerns with volumes of waste generated and waste management

The results from question 1a (Table 4.1) and question 4a (Table 4.2) revealed that a high percentage of students indicated a level of concern with the volumes of waste generated in South Africa (80.3%) and in their local school environment (76.1%). The data percentages which indicated no concerns with the volumes of waste generated were low at (6.1%) and (6.8%) for South Africa and their local school environment respectively. Results further indicate significant differences in the level of concern between the students from the city and township with Phi significance being high in both cases. The key differences that can be highlighted between city and township students was the fact that (64.7%) of the township students were very worried about volumes of waste generated, while the city students were more predisposed to only slightly worried (49.4%). Although the city students were less

Table 4.2: School students concerns around waste volumes generated in their local environment

Q4a. To what extent are you worried about the volumes of waste generated in your School?

	Very Worried	Slightly Worried	Neutral	Not Worried
Total Sample (%)	44.5	31.6	17.1	6.8
Township (%)	65.7	18.8	7.8	7.8
City (%)	28.1	41.6	24.3	6.0



	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.39✻

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice.

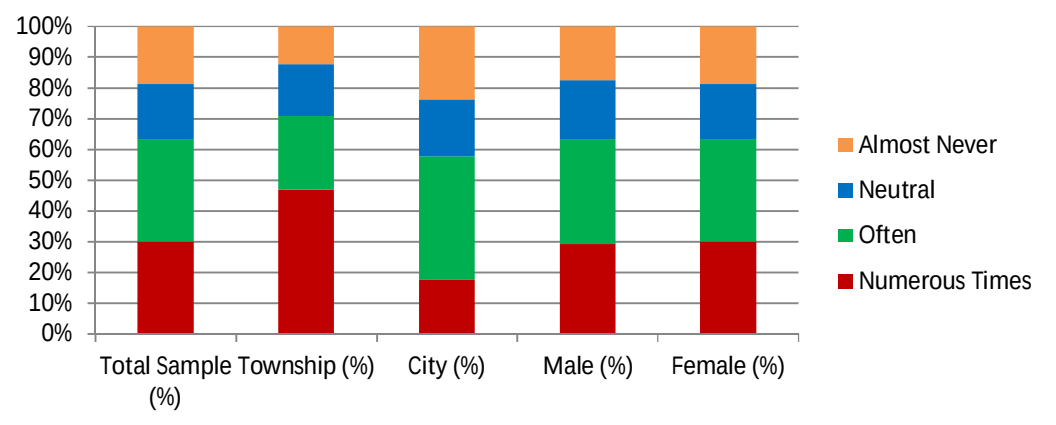
worried they still indicated a definite level of concern. The disparity between the city and township was highlighted further when the data for question 4a (Table 4.2) were evaluated. The concern of the students in the township was again high (65.7%) whereas the city students were again only slightly concerned at (41.6%). The data also showed that the female students were slightly more concerned with waste volumes generated in South Africa; although statistically different it was deemed insignificant based on the low Phi significance as was discussed in Chapter 3. There were no significant differences between results from Grade 7 and Grade 11 students, or between genders.

While these results indicate a definite concern from all the students (Grade 7 and Grade 11) with regard to the waste volumes generated in South Africa, the similar high concern for large waste volumes generated at the schools was not shared by the students from the city. This disparity could probably be explained by the socio-economic differences as well as potential lack of service delivery at the township schools, but must be the objective of another study.

Table 4.3: Students' frequency of concern with how they consider the impact of waste on the environment.

Q13a: How often do you think of waste and the impact it can have on the environment?

	Numerous Times	Often	Neutral	Almost Never
Total Sample (%)	30.3	33.2	17.9	18.7
Township (%)	46.9	23.9	16.8	12.3
City (%)	17.6	40.2	18.6	23.6
Male (%)	29.3	34.1	19.2	17.4
Female (%)	30.3	33.2	17.9	18.7



	Pearson Chi	Phi
Township vs. City	P < 0.05♀	0.34✻
Male vs. Female	P < 0.03♀	0.12 ◊

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice

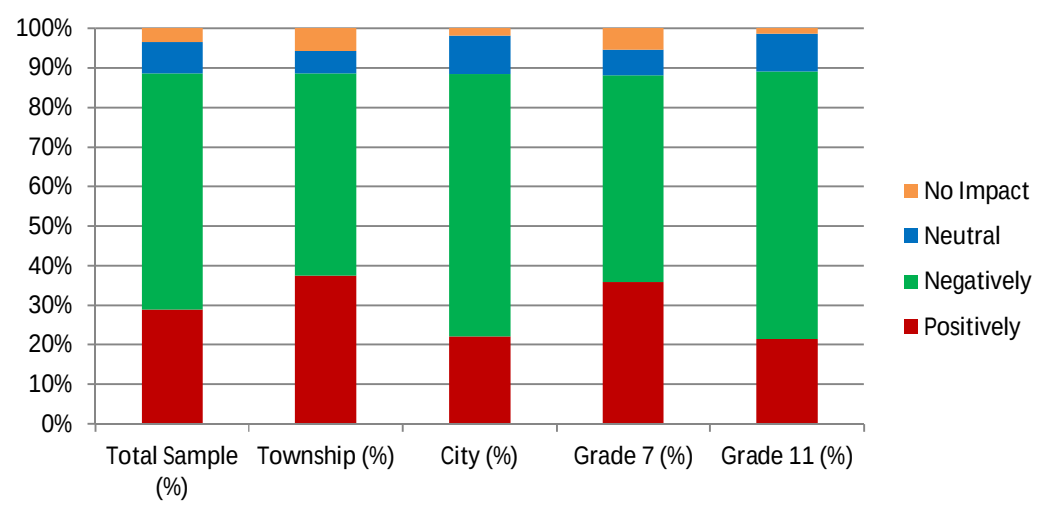
The frequency of student's concern with the impact of volumes of waste generated was determined by question 13a (Table 4.3). The results aim to supplement the concern indicated from students on the volumes of waste generated in South Africa and their local environment by establishing how frequently they consider the fact that waste could have an impact, be it positive or negative, on the environment. More than (63%) of the students acknowledged that they are actively thinking and concerned with waste management which, indicate that the questionnaire did not only prompt them for an opinion on the matter, but that they also have a constant unhappiness about waste in their environment. The results again indicated a significant difference between the township and city. Students from the city seemed to be less unsettled and had a lower tendency to actively think of waste generation and the potential impact it could have on them. This supports the previous results where the students from the townships indicated a higher percentage of concern and level of awareness on waste generation in their respective schools and South Africa. There must be

an understanding that with increased poverty there is usually an interwoven link to poor addressing of environmental matters such as waste management. This poverty does not refer to true rural poverty where waste such as polystyrene plastics etc. is not really known, but rather urban poverty as is known in the South African townships. This rural poverty held true for the township of Embalenhle, the waste issues are complex and compounds with contributing facets such as poor service delivery or the lack of waste handling facilities.

Table 4.4: Students' recognition of impact on their country as a result of poor waste management

Q3a: How do you think poor waste management can impact the future of South Africa?

	Positively	Negatively	Neutral	No Impact
Total Sample (%)	28.8	59.7	7.9	3.5
Township (%)	37.5	51.1	5.5	5.8
City (%)	22.1	66.4	9.8	1.8
Grade 7 (%)	35.9	52.2	6.4	5.5
Grade 11 (%)	21.4	67.6	9.5	1.4



	Pearson Chi	Phi
Township vs. City	P < 0.05♀	0.22✻
Grade 7 vs. Grade 11	P < 0.05♀	0.21✻

♀ Significantly different ✻Significant in Practice

4.2.2 Students' concerns with the impact of good or poor waste management

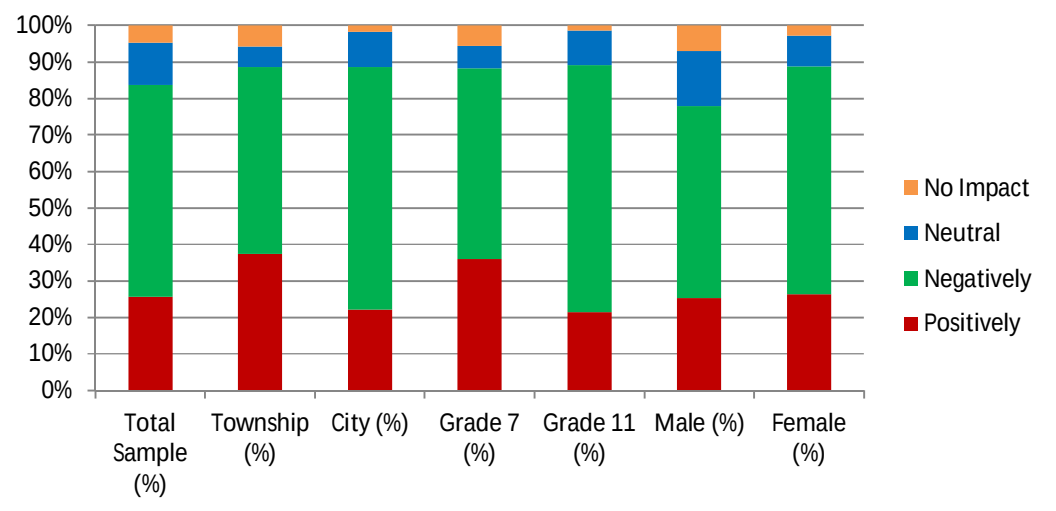
In the theme of awareness the following section aims to understand how students perceive that poor and good waste management will affect the country as well as the individual. The students' awareness of the impact of poor waste management on South Africa was

assessed with Question 3a (Table 4.4) while the impact of poor waste management on the individual was assessed in Question 15a (Table 4.5). Question 16a (Table 4.6) below is aimed to determine whether the students perceive that they will reap potential benefit when waste management performance is unimproved.

Table 4.5: Students' recognition of impact on the individual as a result of poor waste management

Q15a: How do you think poor waste management can impact your own personal future?

	Positively	Negatively	Neutral	No Impact
Total Sample (%)	25.8	57.9	11.6	4.7
Township (%)	37.5	51.2	5.5	5.8
City (%)	22.1	66.5	9.6	1.8
Grade 7 (%)	35.9	52.2	6.4	5.5
Grade 11 (%)	21.4	67.7	9.5	1.4
Male (%)	25.4	52.5	15.0	7.1
Female (%)	26.3	62.6	8.4	2.7



	Pearson Chi	Phi
Township vs. City	P < 0.05♀	0.21✻
Grade 7 vs. Grade 11	P < 0.05♀	0.16 ◊
Male vs. Female	P < 0.05♀	0.16 ◊

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice

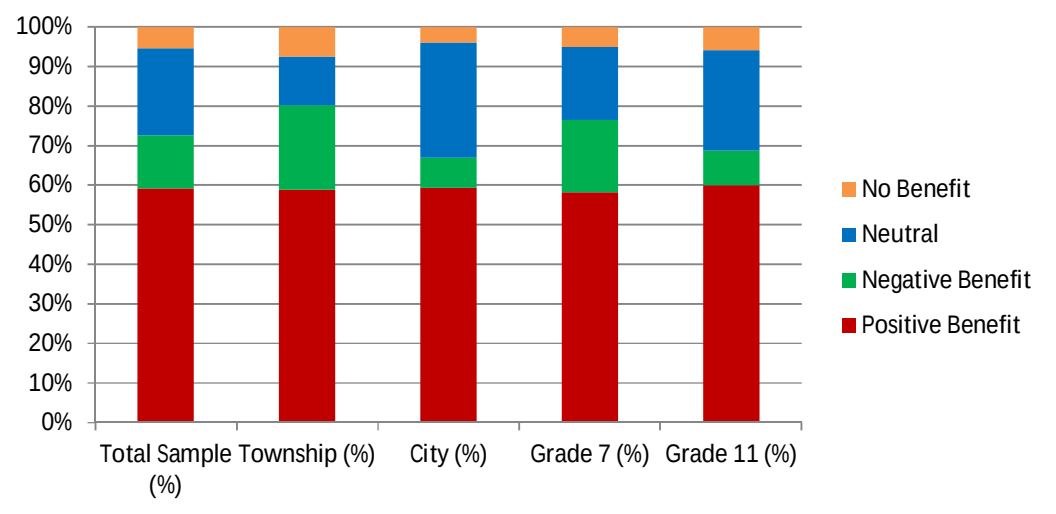
The overwhelming response to the impact of poor waste management on South Africa (Table 4.4) or the individual (Table 4.5) was that it will have be negative on both the country (59.7%) and the individual (57.9%). What is of definite concern is that collectively a high

percentage (40.3%) of students think poor waste management will have a positive or no adverse impact on the country and (42.1%) do not believe that poor waste management will have either a positive or no impact on them as individuals. This was in contradiction with the students' perceived impact (Table 4.6) that good waste management could hold a potential benefit for them (59.1%) with only a low percentage (5.4%) not seeing any benefit coming from good waste management. The results further support the suggestion that there is a lack of understanding of the interconnectedness of waste management issues by the school students.

Table 4.6: Students' perceived benefit from good waste management practices.

Q16a: How do you perceive you will benefit from good waste management?

	Positive Benefit	Negative Impact	Neutral	No Benefit
Total Sample (%)	59.1	13.5	21.9	5.4
Township (%)	58.9	21.4	12.3	7.4
City (%)	59.3	7.6	29.2	3.9
Grade 7 (%)	58.3	18.2	18.5	5.0
Grade 11 (%)	60.0	8.7	25.4	5.9



	Pearson Chi	Phi (Significance in Practise)
Township vs. City	P < 0.05♀	0.32✻
Grade 7 vs. Grade 11	P < 0.05♀	0.15 ◊

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice

Results from the potential impact of poor waste management on the country (Table 4.4) also indicated statistically significant differences between the city and township students, as well as between grade 7 vs. grade 11 students with Phi significance moderately strong in both

cases. The key difference was in the fact that more than (66%) of the city students perceived poor waste management to have a more negative impact, while the township students of only (51.1%) expected a negative impact. This difference could perhaps be explained by the complacency that is setting in amongst the students from the townships because of poor service delivery and the constant poor waste management experienced in their environment, but this wider issue was not within the ambit of this study.

The difference between the grade 7's and 11's regarding the potential impact that poor waste management could have on the country (Table 4.4) indicated that the grade 11 students (66.4%) were significantly more concerned with the potential negative impact on the future of South Africa than the grade 7 (52.2%) students. It could be argued that grade 11 students should be more aware of the negative impacts on the country based on their advanced education and maturity, but this was not evaluated as part of this study. No significant differences were observed between male and female students on the impact of poor waste management in the country.

Results from the potential impact of poor waste management on the individual (Table 4.5) also indicated statistically significant differences between the city and township students, as well as between the grade 7 vs. grade 11 and the male and female students. The strong Phi value shows the significant difference between the city and township students. The significant difference was in the fact that (66.5%) of the city students again perceived poor waste management to have a more negative impact on the individual, while the township students of only (51.2%) expected a negative impact. This close comparison between city and township students concern for both the individual and country could be ascribed to the fact that the students link the perceived impact on them as the individual with their local environment (South Africa).

Question 16a (Table 4.6) was intended to determine whether the students perceive that they will reap potential benefit when poor waste management can be converted into good quality waste management. Although (59.1%) gave a positive response some students still perceived a negative impact (13.5%), a neutral impact (21.9%) or no benefit (5.4%). There was a significant difference between city and township students as well as grade 7 and grade 11 students. Only the Phi significance between city and township students was significant. The significance being that the city students expected a much lower (7.6%) perceived benefit from good waste management compared to the (21.4%) from the township students. This perceived increase in benefit from the township students can possibly be explained by the fact that they are more directly involved in waste management in their

communities when compared to the city students and understand that effective waste management can result in monetary value for them or their communities.

4.3 Knowledge of students for waste and waste management in South Africa

There are two reasons for testing the knowledge on waste generation and waste management in general. The first was to measure the effect of the students' current knowledge on waste generation and waste management, and the second is to highlight the variations in knowledge among students from different socio demographic backgrounds. Athman and Monroe (2000, p. 38) state that: *"Environmental education is a process of developing a world population that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones".* This environmental education process which is intended to work towards sustainable development, and to develop an environmentally literate and competent youth dedicated to resolve manmade environmental problems, is a key aspect to ensure future sustainable development (Gough, 1997).

It is clear that knowledge and education are two different concepts but these two concepts are however intimately linked and that knowledge and education are both critical components in determining a person's understanding of environmental issues. Therefore it is vital to assess the students' knowledge to enable a more accurate understanding of responses towards awareness and practice as is evaluated in this study.

4.3.1 Evaluation of current waste management knowledge of students.

The students' general knowledge on waste generation and waste management was evaluated by asking 10 general knowledge questions (See Appendix I). A mixture of easy and more complex questions was asked. The average number of questions answered correctly by the total group of students evaluated was low at (41%) while the incorrect answers were much higher at an average of (59%) (Figure 4.1). The number of incorrect answers that were given by the students is a concern. As was highlighted knowledge with regards to environmental problems such as waste management is intimately linked to some form of education in that subject. This low level of knowledge could therefore potentially be linked to a lack of education in waste management, which in turn directly affects the capability to address the environmental challenge of poor waste management.

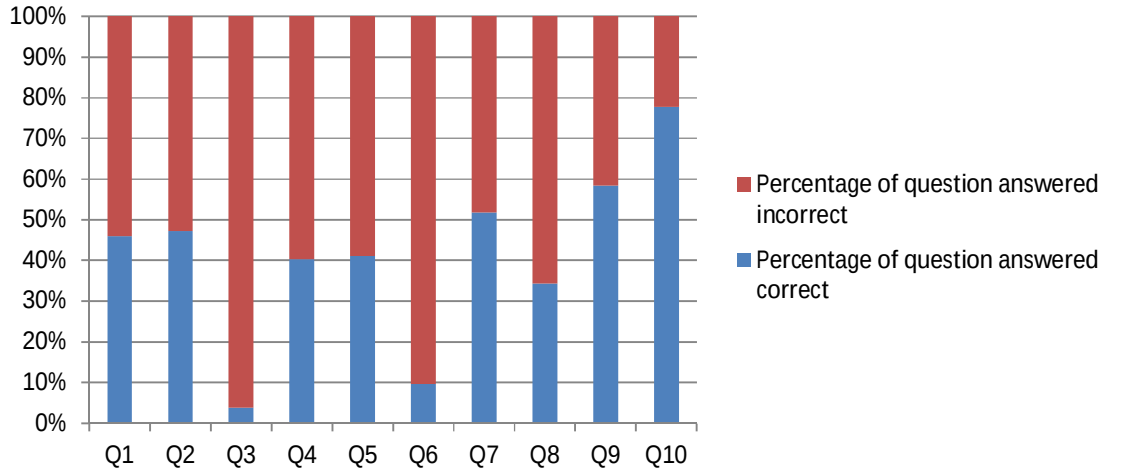


Figure 4.1: A bar graph presenting the percentage ratios of correct and incorrect answers for a set of ten knowledge questions presented in the questionnaire, for the total sample.

There were significant differences for all three socio-demographic variables of location, grade and gender selected questions, but there was however no strong Phi correlation for any of the socio-demographic attributes. This translated to the fact that the questions were answered equally correct or incorrect by the students throughout all the evaluated socio demographic variables.

4.3.2 Questions with high percentages of incorrect answers

Questions 3 and 6 (Figure 4.1 Q3 & Q6) delivered the highest percentages of incorrect answers.

Question 3: In your opinion which one of the following actions is the most favoured option in the concept of waste hierarchy? (Correct answer: Prevention)

Disposal	*Energy Recovery*	*Recycling*	*Reuse*	*Minimization*	*Prevention*

Most students selected the option of recycling which is indicative that the students might not have heard or learnt about the waste hierarchy yet. This is a concern if it is considered that more than 50% of these students are young adults and should have known the answer to this question based on their school education (Curriculum and Assessment Policy Statement Grades 10-12 life sciences, 2013). This could also reflect the failure in the education of students on the implementation of the NWMS goals, which has its foundations in the principle of the waste hierarchy (NWMS, 2010: 18).

Question 6 How long does it (approximately) take to recycle an aluminium can? (Correct answer: Two Months)

Seven Days	*One Month*	*Two Months*	*Six Months*	*One year*

This question could be seen as more of a general knowledge question, but illustrates that the students have at least some knowledge of a waste product that is abundant in South Africa and that is one of the largest recycled products by volume.

4.3.3 Questions with high percentages of correct answers

Question 9 and Question 10 (Figure 4.1) delivered the highest percentages of correct answers

Question 9: What is another term for burning waste? (Correct answer: incineration)

Recycling	Sweeping	Incineration	Grading	Disposal

Question 10: What is the name for the process by which waste material is used again? (Correct answer: Recycling)

Disposal	Energy Recovery	Recycling	Minimization	Prevention

Questions 9 and 10 were answered correctly by a high number of students. This most likely reflects the fact that the concepts of recycling have been taught to the students or that they actually experience these actions as part of their daily activities e.g. incineration of waste in the township, segregation of paper for recycling in the city schools, etc. There were however no significant differences between the socio-demographic variables on the results of these questions which makes the explanation of this inherent knowledge more complex. The knowledge could have been gained through the current education system or gained over time through actions that a more a part of their daily lives and indirectly giving them a better understanding and knowledge base (e.g. burning of waste in the rural communities).

4.4 Practice of students for waste and waste management in their local environment

Sound waste management practice is essential, because students and all other people can be aware and knowledgeable, but if they do not effectively practice sound waste management the desired outcome of effective waste management will be achieved with difficulty. This section aimed to evaluate the school students' current familiarity and involvement in waste management practices in their school as well as home environment. The section further highlights differences between socio-demographic variables and waste management practices.

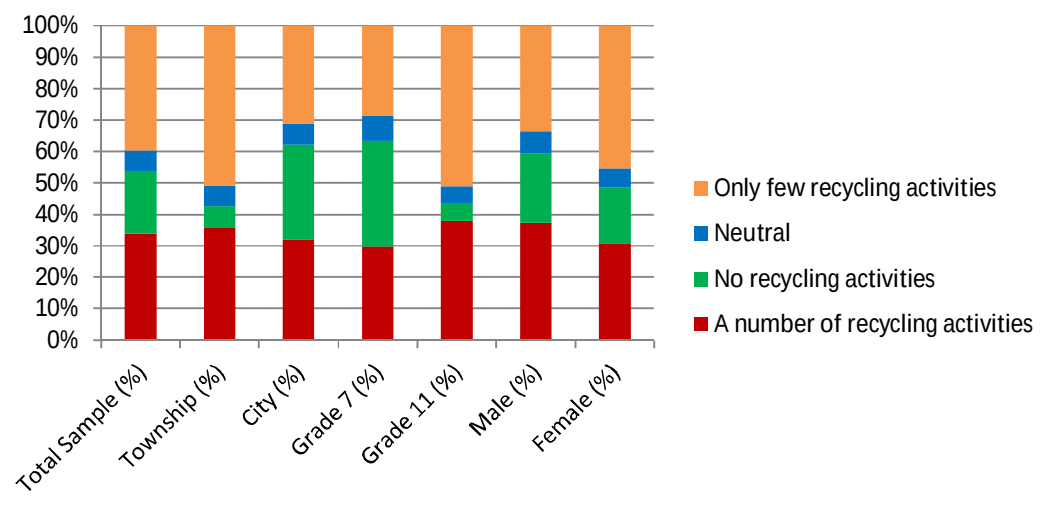
4.4.1 Familiarity and involvement in waste management practices at School

The following two questions aim to determine the students' familiarity and involvement with waste management practices in their schools. Question 5a (Table 4.7) revealed that around one third (33.8%) of the overall students indicated that there are a number of recycling

Table 4.7: Recycling activities at school

Q5a: Are there any waste recycling programs or activities in your school?

	A number of recycling activities	No recycling activities	Neutral	Only few recycling activities
Total Sample (%)	33.8	19.9	6.6	39.7
Township (%)	35.9	6.8	6.5	50.8
City (%)	32.1	30.1	6.8	31.1
Grade 7 (%)	29.8	33.4	8.0	28.7
Grade 11 (%)	37.9	5.8	5.2	51.2
Male (%)	37.2	22.1	7.1	33.6
Female (%)	30.6	17.9	6.2	45.3



	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.3✻
Gr. 7 vs. Gr. 11	P < 0.05♀	0.4✻
Male vs. Female	P < 0.05♀	0.12 ◊

♀ Significantly different ✻Significant in Practice

◊ Statistical Significant difference, but Phi significance to low for justification in practice

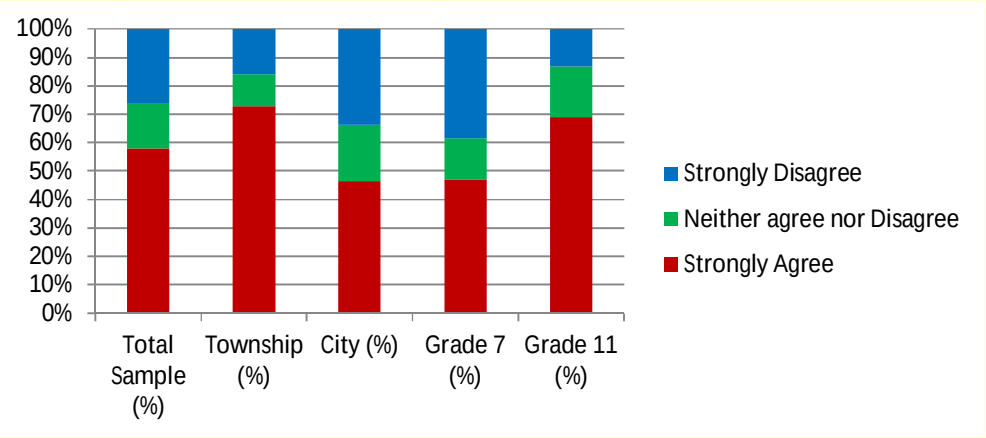
activities at their schools, while (39.7%) indicated only a few recycling activities and the remainder of the students were neutral or unsure. It is of great concern that students differ so much in their knowledge of waste recycling activities at their respective schools. One should expect that all children from the respective schools should know about the recycling activities and that these activities should be promoted.

There were statistically significant differences between the city students and the township students, with ta strong Phi value since 30.1% of the students from the city schools indicated

that there were no recycling activities) as opposed to 6.8% amongst the township students. The township students did not indicate a high number of recycling activities, but rather only few recycling activities as opposed to none. A strong Phi significance was also found between the grade 7 and grade 11 students. The grade 7 students indicated a much higher awareness of no recycling activities (33.4%) when compared to the grade 11 students (5.8%).

Table 4.8: Promotion of waste minimization in schools

Q3p: Waste minimization is promoted in your school?			
	Strongly Agree	Neither agree nor Disagree	Strongly Disagree
Total Sample (%)	57.9	16.2	25.9
Township (%)	72.8	11.3	15.9
City (%)	46.6	19.9	33.5
Grade 7 (%)	47.0	14.6	38.4
Grade 11 (%)	69.1	17.7	13.3



	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.30✻
Gr. 7 vs. Gr. 11	P < 0.05♀	0.30✻

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice

The grade 11 students again opted for higher percentage (51.2%) with only few recycling activities in their local environment. It was found and confirmed by personal observation that the recycling activities at all the schools were actually low with all schools only participating in paper recycling schemes, which could explain the disparity in the results and lower awareness of recycling activities in the schools.

In some cases male students were more aware of recycling efforts than females and there were also statistically significant differences between male and female students on the waste recycling programs in the respective schools, but Phi significance was low.

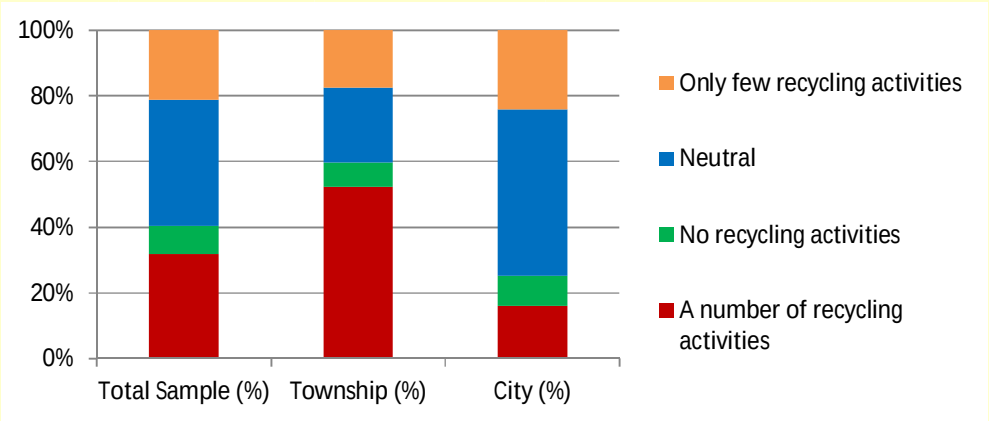
The school students were also asked whether waste minimization is promoted in the schools Question 3p (Table 4.8), and 57.9% of the students indicated that waste minimization is indeed promoted while only 25.9% strongly disagreed and the remainder of the students gave a neutral response. The results further indicated significant differences between the city and township students with Phi values in practice being quite strong. The results from the schools in the city show that waste minimization was perceived to be less promoted in their schools while the township students again stated a larger focus on waste minimization. This could again be due to the more severe impact of waste in the townships (e.g. windblown waste; poor service delivery and the potential to earn money with improved waste management). As part of the promotion for waste minimisation the grade 7 students also perceived lower promotion of waste minimization when compared to the grade 11 students with strong Phi significance to support the result. This reason for this significant difference between the grades can only be explained by the much higher promotion of waste minimization in the secondary schools, and perhaps its occurrence in the secondary school syllabus.

4.4.2 Familiarity and involvement in waste management practices at home

The study further aimed to determine the waste management practices of the students at home. The students were asked about their recycling initiatives where they live and in their homes (Question 8a and question 4p). What is concerning is that from all the students less than 40% recycle waste at home (Table 4.9). The results in the township homes correlated well with all the results presented in this study where the township homes were again more focused when compared to the city homes. The Phi significance was strong and the combined percentages for recycling activities were 69.9% for the township which is high compared to the 40.1% initiatives in the city (Table 4.10). This was again confirmed when the students' were asked if they recycled at home. A high percentage (50.8 %) of students in the township recycled at home while only 30.9% of the student's in the city sorted and recycled at home (Table 4.10).

Table 4.9: Waste recycling programs in the neighbourhood

Q8a: Are there any waste recycling programs or activities where you live?	A number of recycling activities	No recycling activities	Neutral	Only few recycling activities
Total Sample (%)	31.9	8.5	38.4	21.2
Township (%)	52.4	7.4	22.7	17.5
City (%)	16.0	9.3	50.6	24.1



	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.41✻

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice

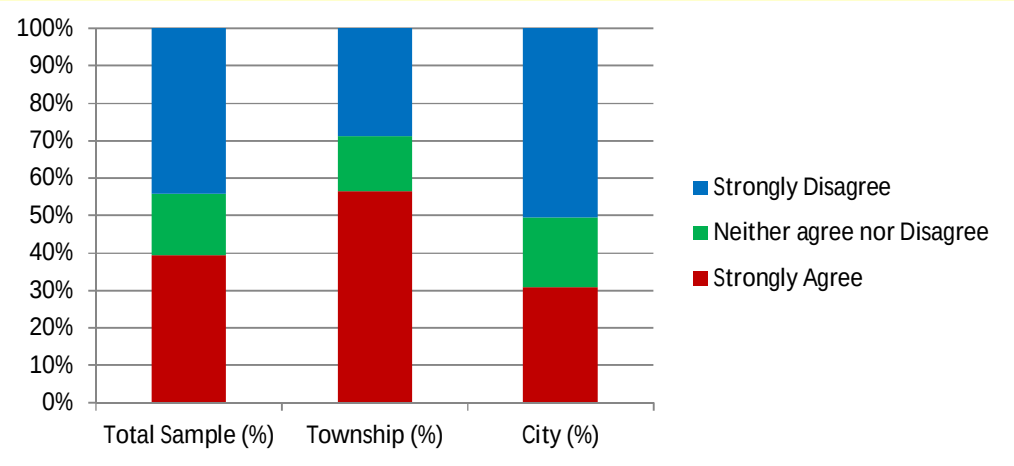
4.4.3 Key outcomes on Awareness, Knowledge and Practice of students.

The aim of the questionnaire was to determine their awareness, knowledge and practice with regards to waste and waste management in South Africa and their local environment. The data were collected in three sections (awareness; knowledge and practice) and the key outcomes from these sections can be summarised as.

In the awareness section (Section 1) all students (Grade 7 and Grade 11) showed high levels of concern with waste volumes generated in South Africa and in their local environment. Although the concern was high for both townships and city students, the data showed that students from the townships were more concerned with waste volumes. It was further evident that female students were more concerned with waste and waste management. All students indicated that they are regularly and actively thinking about waste and the impact on the environment.

Table 4.10: Waste segregation and recycling at home

Q4p: Do you sort and recycle your waste at home?	Strongly Agree	Neither agree nor Disagree	Strongly Disagree
Total Sample (%)	39.5	16.3	44.2
Township (%)	50.8	13.3	25.9
City (%)	30.9	18.6	50.5



	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.31✻

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice

Students perceived poor waste management to have a negative effect on the environment, but also on them as individuals. There was however a fairly large number of students that did not seem to realise that poor waste management could have a potential negative impact on them or their surrounding environment. This indifference was pronounced between city and township students and could potentially be explained by the fact that waste management in the townships is hampered by poor service delivery. Waste also holds more potential monetary value for people in townships compared to cities. The data also highlighted that grade 11 students were more aware of the potential negative impacts of poor waste management on them as individuals and on the environment, and this awareness could probably be credited to a higher level of maturity.

In the knowledge section (Section 2) the students' knowledge on waste and waste management aspects was found to be poor for both the grade 7 and grade 11 students. This is highlighted as a concern since youth literacy in environmental problems and solutions is vital to work towards a sustainable future.

From the practice section (Section 3) it was evident that there were significant differences between the waste management practices in the township and in the city. The students located in the city recycled less at schools and at home when compared to the township students. Waste recycling seemed to be a more focused activity in the townships, which agrees with the findings from the awareness section, were students from the township were more aware of waste and waste management.

4.5 Attitude: combining Awareness, Knowledge and Practice

Attitude was not directly addressed in the ambit of this study but awareness, knowledge and practice are all linked into and combined into the attitude and values of a specific individual (Palmer, 1998; Hawthorne and Alabaster 1999). It was also found in this study that some questions answered by the students did not deliver results with significant differences between different socio-demographic groups, but still revealed interesting aspects about the views and attitudes of the students towards waste management. This section highlights some of these interesting questions and will briefly discuss their relevance and why it is worthy of a discussion.

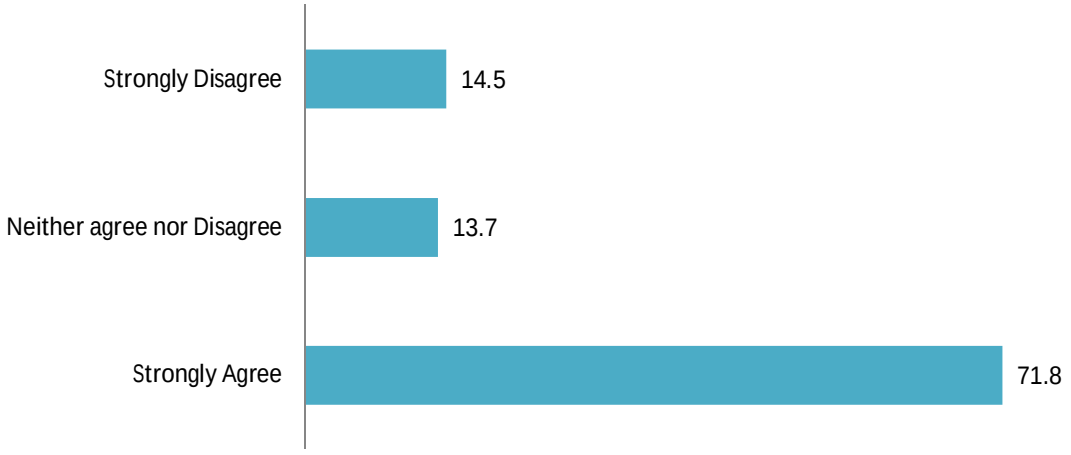


Figure 4.2: Graphic illustration of percentage response results for the question "Will you try and persuade your friends that waste management is important to protect the environment?"

Results from Figure 4.2 revealed a positive response (71.8%) from all students when asked if they will try to persuade a friend that waste management is an important action to ensure protection of the environment. This positive response is a flicker of hope and an indication that the students are willing to discuss potential environmental problems with their peers. It is however still concerning that 14.5% of the students were not willing to persuade their friends

of the potential benefits or the importance of good waste management and the impact it could have on their future.

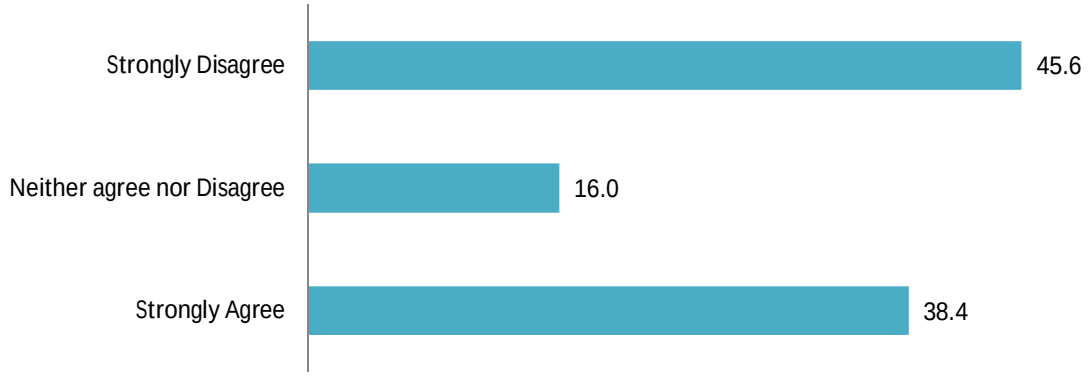


Figure 4.3: Graphic illustration of a percentage response results for the question "Will you donate some of your pocket money towards waste management?"

Figure 4.3 almost delivered a comically interesting result for the question on whether the students will be willing to donate some of their pocket money towards waste management. It is only logical that grade 7 and grade 11 students should not want to part with their pocket money easily and although the majority (45.6%) clearly indicated that they would not want to share their wealth it was promising to see that 38.4% of the students were willing to contribute towards waste management. These results suggest that these students understand some key aspects of waste ranging from the awareness that capital is required to initiate waste management, as well as an awareness of the potential profitability of waste management.

The results from Figure 4.4 indicated the students learn most about waste management from radio/television (43.9%), followed by school/textbooks (31.5%), while lower than expected numbers were indicated for internet (9,1%), newspapers/magazines (9.1%) and family/friends (3.1%). The findings correspond well with those from a study where 8th graders were evaluated in Turkey by Yurttas and Sülüna (2010), where radio and television were also highlighted as the most prevalent source (25%) for information on waste management, closely followed by the internet (23.6%) and newspapers and magazines (21.3%). The internet (9.1%) and magazine/newspaper (9.1%) also had an equal influence on the South African students, but with significantly lower percentages than the Turkish study. This result could be attributed to lack of access to internet and magazines or newspapers for the students in the township since they comprised more than half of the questionnaire respondents. This study also revealed that a higher percentage of South African students obtained their information from school or textbooks (31.5%) when compared to the (15.5%)

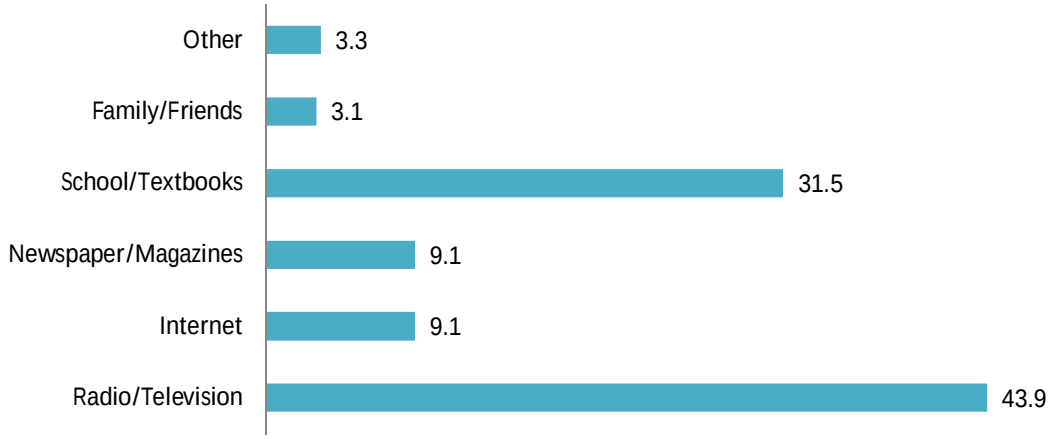


Figure 4.4: Graphic representation of percentage response results for the question "Where do you learn most about waste and waste management?"

of the Turkish students. In both the South African (3.1%) and Turkish (10.8%) study close family and friends ranked low as a source of knowledge on waste management. One probable cause for this low percentage of information from family or friends could be linked to lack of knowledge about waste management for families, adults or even teachers. Most likely the reverse is true with regard to the older generation, where children/young people are the primary source of information on waste management and emphasizes the importance of proper education on waste generation and waste management for children.

4.6 Conclusion and Recommendations

This chapter set out to address the third objective of this study: To describe and critically evaluate the data collected on the behaviour (awareness, knowledge and practices) of a sample of primary (Grade 7) and secondary (Grade 11) school students in Mpumalanga. Data were analysed and evaluated for the three key sections (awareness; knowledge and practice) and was presented to distil well-defined outcomes for discussion and interpretation. Results showed that students had a high awareness with regards to waste and waste management for both their local and national environment. The study highlighted the concern of low waste and waste management knowledge of a large number of students from all grades. Waste management practice such as recycling was not prevalent for both the townships and city students. The last section of this chapter briefly discussed results that were not necessarily statistically significant, but still revealed interesting aspects about the views and attitudes of the students towards waste management. The findings from this chapter will contribute to the findings, conclusions and recommendations in the chapter to follow.

5 Chapter 5: Interpretation and Conclusions

5.1 Introduction

The chapter starts by summarizing the research results in relation to the different objectives that was set out for the study. Section 5.3 gives an overall conclusion and interpretation on the waste management behaviour of school students in Mpumalanga, South Africa. Finally the chapter presents recommendations on features that future studies may consider.

5.2 Summary of results and objectives

The aim of this study is to investigate and understand school students' views on waste and waste management in South Africa and their local environment. In order to achieve the overall research objective the three objectives as presented in Chapter 1 of this study will be highlighted and discussed.

Objective 1: To review relevant literature dealing with waste management awareness, knowledge and practices of school students.

In Chapter 2 an introductory overview was given of literature on the sustainable development of local and international waste management. It was presented that large volumes of waste generation and ineffective waste management by man is a problem negatively affecting the environment. Generation of large volumes of waste cannot continue indefinitely and is not conducive for sustainable development. Working towards sustainable development has many challenges especially in developing countries such as South Africa.

Historically waste management was only focussed on disposal to protect public health, but this will have to change to a systems approach to understand the number of complex problems to effectively manage nature and its resources. Such a systems approach was highlighted in the concept of waste hierarchy. Environmental awareness has gone from strength to strength in the past two decades but there is still room for improvement. It is awareness and behaviour on the individual level which need to develop further and faster to guide South Africa to a more sustainable future. Children especially could play a pivotal role towards sustainable development as they are seen as future decision makers and agents for change, be it individually or collectively. The section further stated that sustainable development is crucial for children's future and the understanding of their current awareness, knowledge and practice.

A number of international studies were found on combinations of behavioural analysis of school students with regards to waste management, but only a very limited number of studies were to be found for South Africa, thereby justifying the need for this investigation.

The section further discusses the behavioural aspects of awareness, knowledge and practices individually. Awareness is narrowly linked with education and found to often be a key part of countries' waste management strategy across the world. Knowledge was also found to be intimately linked to education. Education possesses the capability to meet environmental challenges through promoting awareness and knowledge on issues changing people's attitudes and evidently their behaviour. Knowledge and awareness can therefore be seen as critical parameters to measure a person's understanding of environmental issues. The literature review further highlighted that it is imperative to translate the awareness and knowledge into practice, because without effective practice results will not materialize in solving complex problems such as waste management.

The conclusion from this section is that there should be a focused approach to turn philosophy (research) from environmental studies into good practice towards sustainable development. Lack of research on waste management behaviour should be better understood not only for children but for all ages of the population. Fundamentally understanding behavioural aspects such as awareness, knowledge and practice can contribute to improved waste management problem solving and ultimately a more sustainable future.

Objective 2: To discuss the principles, objectives and targets of the South African Government towards waste and waste management.

Chapter 2 gives the current legal framework with regard to waste management in South Africa. At the basis the Constitution of South Africa, (Act 108 of 1996) provides the foundation for environmental regulation and policy. It supports the right to environmental protection and to live in an environment that is not harmful to health or wellbeing as set out in the Bill of rights (Section 24 of Chapter 2).

ECA was promulgated during 1989 and was one of the first significant pieces of legislation regulating effective protection and controlled utilization of the environment with specific reference to waste management in South Africa. ECA did not only define waste but also regulated the disposal of waste at disposal sites. The evolvement of waste legislation in

South Africa is further highlighted. The Draft White Paper on Integrated Pollution and Waste Management for South Africa leading to government drafting and promulgating legislation requiring prevention and minimization of waste. It is then argued that there is significant fragmentation in the South African waste legislation framework that needs to be addressed. However fragmentation is complex problem that is not easy to solve and requires tools such as quality education (which includes awareness and knowledge) to assist with the reduction of fragmentation over time.

The section was concluded by again referring to the instrumental role children play and the change they can bring about in society. The exclusion of children in critical community decisions is criticized and it is further discussed that this was also the case in the legal mandate and strategy of the South African Government. Although education advocacy is implied in the legal framework and IWMS the direct role and active inclusion of children is not addressed. Children in South Africa need to be empowered as world citizens and agents of change to ensure environmental problems such as waste management is effectively dealt with for a sustainable future.

Objective 3: To describe and critically evaluate the data collected on the behaviour (awareness, knowledge and practice) of a sample of primary and secondary students in Mpumalanga, South Africa.

5.2.1 Awareness

This study worked towards establishing the baseline of descriptive information of the preconceptions, ideas, and beliefs of a sample of grade 7 and grade 11 students in Mpumalanga, South Africa, by evaluating their awareness, knowledge and practices of waste management. The research provided insight on what a current group of primary and secondary school students know and consider about waste management and practices in their country and local environment.

Findings from the study clearly indicated that all the students, grade 7 and grade 11, were aware that waste management is a serious environmental problem in their schools as well as in South Africa. The results also indicated that poor waste management raised an evidence of concern with the students and that their daily awareness of waste management was considerable. These concerns were also supported by the responses that students were aware that poor waste management will not only negatively affect their own future and that of South Africa, but that good waste management can in fact hold a benefit for them. Similar

high levels of environmental awareness from students were found in recent publications (Duan and Fortner 2005; Ifgegbesan 2010; Tomažiča and Vidic, 2011; Desa *et al* 2010).

No significant gender differences were observed on the awareness w.r.t waste management which compared well with findings form other authors on gender and environmental perception (Chanda, 1999; Eagles and Demare's 1999; Eagles and Muffitt 1990; Blocker and Eckberg 1997; Dietz *et al* 2002; McCright, 2010).

In all cases of awareness the socio-demographic variable of township vs. city was consistently highlighted as significantly different in practise between the samples of students. Students from the townships (rural and poorer) consistently expressed larger concern w.r.t waste volumes generated in South Africa as well as in their local school environment and also indicated that they are more often concerned by how poor waste management can negatively impact them or how good waste management can potentially benefit them. Students from the city (urban) schools were also concerned but by a generally noticeably lesser degree than their township equivalents. The students from the city schools also indicated that they were not thinking about poor waste management as often. They were also less aware on how and why poor waste management could negatively affect them or how they could actually benefit from good waste management.

No studies to support these specific findings of the school students' differences in awareness among township and city students in South Africa could be found. However there are a number of international studies that noted a trend in the disappearance of rural-urban differences in environmental behaviour (Buttel and Flinn, 1978; Leftridge and James, 1980; Arcury, and Christianson, 1990). However Bogner and Wiseman (1997) still found significant differences in environmental behavior between urban and rural students in Bavaria. There is no clear explanation for the significant differences found between urban and city students in this study but it could be because of a number of socio-demographic variables that were not explicitly investigated as part of this study. Some of these variables could include differences in municipal waste generation volumes, excessive lack in service delivery and poor township infrastructure when compared to city or the potential for additional monetary value of waste in the rural communities.

5.2.2 Knowledge

The data from the research indicated poor environmental knowledge on waste and waste management across the board for grade 7 and grade 11 students. Many studies have found

a relation between knowledge awareness and practice and the studies indicated that the students had a lack of environmental knowledge (Hausbeck, 1992; Schulze, 1993; Madanay and Bugahoos, 1998; Ifegbesan, 2010; Desa *et al* 2010; Tomažiča and Vidic 2011; Tayci and Uysal, 2012).

Lack of knowledge and ignorance towards environmental problems can be seen as one of the major risks for working towards a sustainable future. Knowledge need to be managed as a critical component to establish the school students understanding of environmental issues. Investment in knowledge will lead to improved practice and mitigate the risks towards a sustainable future.

Research literature also showed the importance of the link between education and knowledge on environmental problems such as waste management, but this was not evaluated as part of this study since the focus was on first establishing a descriptive base line of waste management knowledge.

The level of understanding of basic waste management concepts in this study was disappointing. Education for young adults on environmental knowledge for waste and waste management will have to be increased, improved and promoted in South Africa. Although the environmental curriculum was not evaluated as part of this study it should be understood that it is not only the content of the curriculum that should be adequate, but also the manner in which this critical environmental information is transferred to the children. With successful transfer of knowledge government will create the opportunity for change in awareness practice and attitude.

5.2.3 Practice

This study revealed that the students' awareness and knowledge of waste management practices in their schools and at home was poor. Waste recycling activities were higher in the townships when compared to the activities indicated by the city students. Data also indicated the schools in the city did not promote waste management activities as effectively as the schools in the townships. The practice and promotion of waste management was also more prevalent in the secondary schools when compared to the primary schools.

The transformation of environmental awareness and knowledge into practice is one of the most significant behaviours that need to be achieved by the South African Government to work towards an effective implementation of the IWMS and the drive towards sustainable development. Practice of good waste management can be seen as a person's willingness to

alleviate one of many environmental problems in the world. The shaping of young minds to enable them to change behaviour to live and promote more environmentally friendly practices must become a key focus not only in South Africa but throughout the world.

5.2.4 Attitude

Attitude was not directly addressed in the ambit of this study, but it was found that a number of results from the questionnaire delivered interesting qualitative results. Students showed a positive attitude towards waste management to protect the environment. Students were willing to discuss environmental problems with their peers; and they were willing to donate some of their pocket money towards waste management. This positive attitude from the students is promising and a first step towards environmentally supportive behaviour. This positive attitude should be harnessed and grown into an environmental value-add ethos by government. Students are willing, curious and even seem to be committed to work towards a better more sustainable future and this must be harnessed appropriately. Children are continuously adopting, modifying, and abandoning attitudes to fit their ever changing needs and interests. Attitude cannot be changed by simple education only. The South African Government will have to use improved ways to educate, inform and promote environmental problems.

Another positive finding was that students did indicate that their information with regards to waste and waste management was learned at school. However digital media such as radio and television were by far the most prominent source of information for the students. The data from the study compared well to the Turkish study done by Yurtas and Sülüna (2010). The South African Government should use data generated by these environmental studies to adapt and improve their strategies on how to educate school students (e.g. Applications for Cellphones and Tablets, Online training and many other forms of digital media).

5.3 Overall Conclusion

The study examined the awareness, knowledge and practice concerning waste management for a sample of grade 7 and grade 11 school students in Mpumalanga, South Africa. A literature review revealed a paucity of published research dealing with the awareness, knowledge and practice of primary and secondary school students on waste and waste management in South Africa. The study showed that the students were obviously aware of concerns with waste and waste management practices in their schools and local environment. It was also apparent the school students had an acute awareness that poor

waste management would have a negative impact on the country as well as on them as the individual. This prominent awareness was however not evident in the students' waste management practices. Good waste management practices activities were minimal at both the school and home environment. The poor waste management practice could potentially be linked to the inadequate knowledge illustrated by the students in waste and waste management.

Since school students are seen as one of the key agent of change to work towards a more sustainable future, they should be engaged as young as possible and given a quality array of continuous learning to improve their knowledge on environmental problems such as poor waste management. Improved knowledge would contribute to improved environmental awareness and a pro-environmental attitude. The critical recommendations of the study are that the South African Government will have to intensify the research to better understand the needs of school students to environmental matters such as waste management. These actions should include:

- To do further and continuous research
- To use the research data to put more effort into educating students using improved methodologies.
- To increase school students knowledge and awareness to bring about considerable change to the way they practice waste management.
- To empower children as agents of change and environmental citizens of a sustainable future for generations to come.

5.4 Recommendation for future research

Based on the results of the study, it is evident that further assessment of school students in South Africa is required to determine an all-encompassing understanding of their awareness, knowledge and practices for waste and waste management.

The limitations of this study are that the results cannot be generalized for schools in all provinces of South Africa. In the future, an extended study could be conducted to cover more schools and include private schools. The study can be further expanded to compare and evaluate data from South African schools with international schools.

A number of socio-demographic variables were not considered in the ambit of this study. Increased socio-demographic information could assist in improved explanation, clarification and understanding of data trends found in this study.

Further research should be considered on how to apply and incorporate the knowledge and insight gained from this study and similar studies to add value and include students as part of the South African Governments' future environmental strategies towards sustainable development.

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Appendix I : Grade 7 and 11 Student Questionnaire on Waste Management perspective in their school and at home (2012)

Grade 7 and 11 Student Questionnaire on Waste Management perspective in their school and at home (2012)

Please fill in the following table:

School	
Grade	
Age	
Sex	☐ **Male** ☐ **Female**
Home	☐ **Secunda** ☐ **Evander** ☐ **Leandra** ☐ **Kinross** ☐ **Embalenhle** ☐ **Trichardt** ☐ **Other**
Home Language	☐ **English** ☐ **Afrikaans** ☐ **Zulu** ☐ **Sotho** ☐ **Other**
Ethnicity	☐ **Black** ☐ **White** ☐ **Indian** ☐ **Asian** ☐ **Other**

Mark preferred answer with "X" as illustrated in Example below

a. What is a Major source of radio-active waste in South Africa ? **(Choose only 1)**

Factory smoke	Petrochemical leaks	Hospital X-rays	Domestic treatment plants
		X	

Awareness

1. To what extent are you worried about the volume of waste generated in South Africa ? **(Choose only 1)**

Very Worried	Slightly Worried	Neutral	Not worried
1	2	3	4

2. To what extent are you interested in waste recycling in South Africa ? **(Choose only 1)**

Very Interested	Slightly Interested	Neutral	Not Interested
1	2	3	4

3. How do you think poor waste management can impact the future of South Africa ? **(Choose only 1)**

It can impact the countries future Positively	It can impact the countries future Negatively	Neutral	It will not impact the countries future at all
1	2	3	4

4. To what extent are you worried about the volumes of waste generated in your school ? **(Choose only 1)**

Very Worried	Slightly worried	Neutral	Not Worried
1	2	3	4

5. Are there any waste recycling programs or activities in your school? **(Choose only 1)**

There are a number of recycling initiatives	There are no recycling initiatives	Neutral	There are only few recycling initiatives
1	2	3	4

6. To what extent are you interested in waste recycling in your School ? **(Choose only 1)**

Very Interested	Slightly interested	Neutral	Not interested
1	2	3	4

7. Which of the following waste management activities do you use at school ? **(Choose Yes or No for each Line)**

	Yes	No
Separate Paper Waste	**A1**	**A2**
Separate Plastic Waste	**B1**	**B2**
Separate Glass Waste	**C1**	**C2**
Compost Organic Waste	**D1**	**D2**
Participate in buyback or recycling schemes	**E1**	**E2**

8. Are there any waste recycling programs or activities where you live ? **(Choose only 1)**

There are a number of recycling initiatives	There are no recycling initiatives	Not Sure	There are only few recycling initiatives
1	**2**	**3**	**4**

9. How important is the actions in the table below in dealing with waste for you ? **(Choose 1 for every action)**

	Very important	Important	Neutral	Slightly important	Not important
Placing waste in a waste collection drum	**A1**	**A2**	**A3**	**A4**	**A5**
Sorting the waste into separate drums (e.g. Paper, glass and Plastic)	**B1**	**B2**	**B3**	**B4**	**B5**
Recycling and reusing waste	**C1**	**C2**	**C3**	**C4**	**C5**

10. Which of the following waste management activities do you use at home ?
(Choose Yes or No for each Line)

	Yes	No
Separate Paper Waste	**A1**	**A2**
Separate Plastic Waste	**B1**	**B2**
Separate Glass Waste	**C1**	**C2**
Compost Organic Waste	**D1**	**D2**
Participate in buyback or recycling schemes	**E1**	**E2**

11. Where do you learn most about Waste and Waste Management ? **(Choose only 1)**

Radio/Television	**1**
Internet	**2**
Newspapers/Magazines	**3**
School/Textbooks	**4**
Family/Friends	**5**
Other	**6**

12. Would you want to be part of a waste recycling initiative in your school or community ?
(Choose only 1)

Absolutely	Definitely Not	Not Sure
1	2	3

13. How often do you think of waste and the impact it can have on the environment ?
(Choose only 1)

Numerous Times	Often	Neutral	Seldom	Almost Never
1	**2**	**3**	**4**	**5**

14. How serious is the following type of pollution for you? **(Choose 1 for every line)**

	Very Serious (Critical)	Serious	Neutral	Not too Serious	Not Serious at all
Air Pollution	**A1**	**A2**	**A3**	**A4**	**A5**
Soil Pollution	**B1**	**B2**	**B3**	**B4**	**B5**
Water Pollution	**C1**	**C2**	**C3**	**C4**	**C5**

15. How do you think poor waste management can impact your own personal future ? **(Choose only 1)**

It can impact my future Positively	It can impact my future Negatively	Neutral	It will not impact my personal future at all
1	**2**	**3**	**4**

16. How do you perceive you will benefit from good waste management ? **(Choose only 1)**

It can have a major positive benefit for me	It can have a major negative benefit for me	Neutral	It will not have any benefit for me personally
1	**2**	**3**	**4**

Knowledge

1. Which type of waste is generated in the largest volumes in South Africa ? **(Choose only 1)**

Agriculture	Mining	Health	Food	Petrochemical
1	**2**	**3**	**4**	**5**

2. In your opinion does the South African Government have an integrated waste management Plan ? **(Choose only 1)**

Yes - An integrated waste management plan is in place	No - There is no integrated waste management plan
1	**2**

3. In your opinion which one of the following actions is the most favoured option in the concept of waste hierarchy ? **(Choose only 1)**

Disposal	Energy Recovery	Recycling	Reuse	Minimization	Prevention
1	2	3	4	5	6

4. Why is polystyrene counted and handled separately in waste clean-up? **(Choose only 1)**

It floats on water	It is toxic and breaks into smaller particles	It is different in colour	It is lighter than paper	It is blown around by the wind
1	2	3	4	5

5. How many times can glass be recycled ? **(Choose Only 1)**

Once	Ten times	Fifty Times	Indefinitely	Cannot be recycled
1	2	3	4	5

6. How long does it (approximately) take to recycle an aluminium can ? **(Choose only 1)**

Seven Days	One Month	Two Months	Six Months	One year
1	2	3	4	5

7. What are the effects of waste disposal to the earth ? **(Choose only 1)**

Oxygen, Trees and Natural Resources are wasted to make space for landfill of waste	1
Contamination of Soil	2
Contamination of Water	3
Contamination of Atmosphere	4
All of the above	5

8. In which waste group does household garbage belong ? **(Choose only 1)**

Hazardous Waste	Nuclear Waste	Non Hazardous Waste	Electronic Waste	Special Waste
1	2	3	4	5

9. What is another term for burning waste ? **(Choose only 1)**

Recycling	Sweeping	Incineration	Grading	Disposal
1	2	3	4	5

10. What is the name for the process by which waste material is used again ? **(Choose only 1)**

Disposal	Energy recovery	Recycling	Minimization	Prevention
1	2	3	4	5

Do you agree with the following statements:

11. "Old electronics (televisions, computers, printers, game consoles) that gets Disposed of is classified as E-waste" **(Choose only 1)**

Strongly Agree	Slightly Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1	2	3	4	5

12. "Domestic waste can cause air pollution" **(Choose only 1)**

Strongly Agree	Slightly Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1	2	3	4	5

13. "Domestic waste can be converted into compost" **(Choose only 1)**

Strongly Agree	Slightly Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1	2	3	4	5

14. "Land filled waste sites has the potential to cause ground water pollution" **(Choose only 1)**

Strongly Agree	Slightly Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1	2	3	4	5

Practices and behaviours

Do you agree with the following statements:

1. "Waste is generated at your school" **(Choose only 1)**

Strongly Agree	Slightly Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1	2	3	4	5

2. "If waste is generated at your school it is recycled" **(Choose only 1)**

Strongly Agree	Slightly Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1	2	3	4	5

3. "Waste minimization is promoted in your school" **(Choose only 1)**

Strongly Agree	Slightly Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1	2	3	4	5

4. "You sort and recycle your waste at home?" **(Choose only 1)**

Strongly Agree	Slightly Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1	2	3	4	5

5. "You will donate some of your pocket money towards waste management" **(Choose only 1)**

Strongly Agree	Slightly Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1	2	3	4	5

6. "You will try to persuade your friends that waste management is important to protect the environment" **(Choose only 1)**

Strongly Agree	Slightly Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1	2	3	4	5

7. " You want to be part of a team that picks up paper in your neighbourhood and school" **(Choose only 1)**

Strongly Agree	Slightly Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1	2	3	4	5

8. "Everybody is making too big fuss over waste management in my school " **(Choose only 1)**

Strongly Agree	Slightly Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1	2	3	4	5

End Of Questionnaire – Thanks for your participation

Appendix II: All data collected from questionnaire statistically analysed and expressed in table and graph formats.

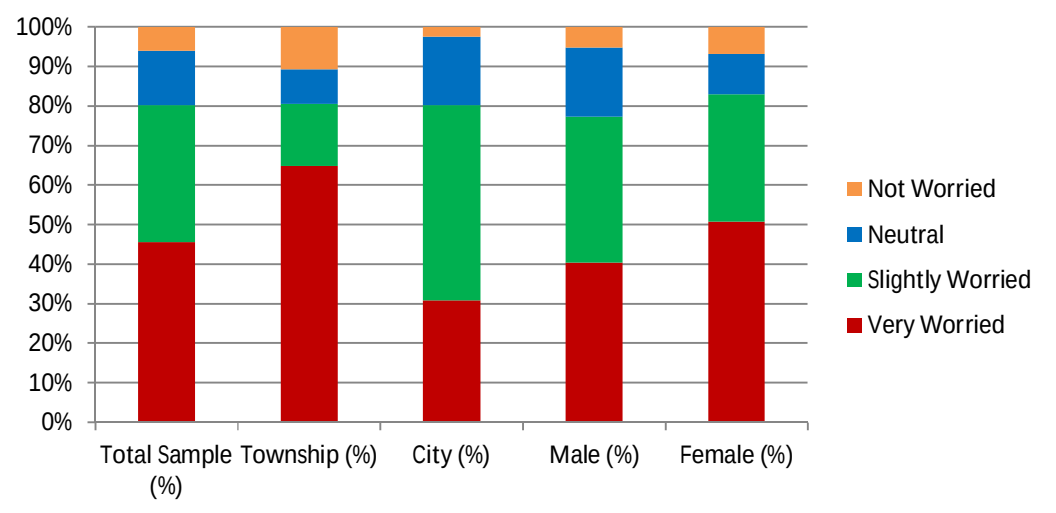
Only data that delivered significant differences were graphed.

I. Awareness of waste and waste management

Table 1: School students concerns around waste volumes generated in South Africa

Q1a. To what extent are you worried about the volumes of waste generated in South Africa?

	Very Worried	Slightly Worried	Neutral	Not Worried
Total Sample (%)	45.6	34.7	13.6	6.1
Township (%)	64.7	15.9	8.7	10.7
City (%)	30.8	49.4	17.3	2.5
Male (%)	40.4	36.9	17.4	5.3
Female (%)	50.4	32.	10.0	6.8

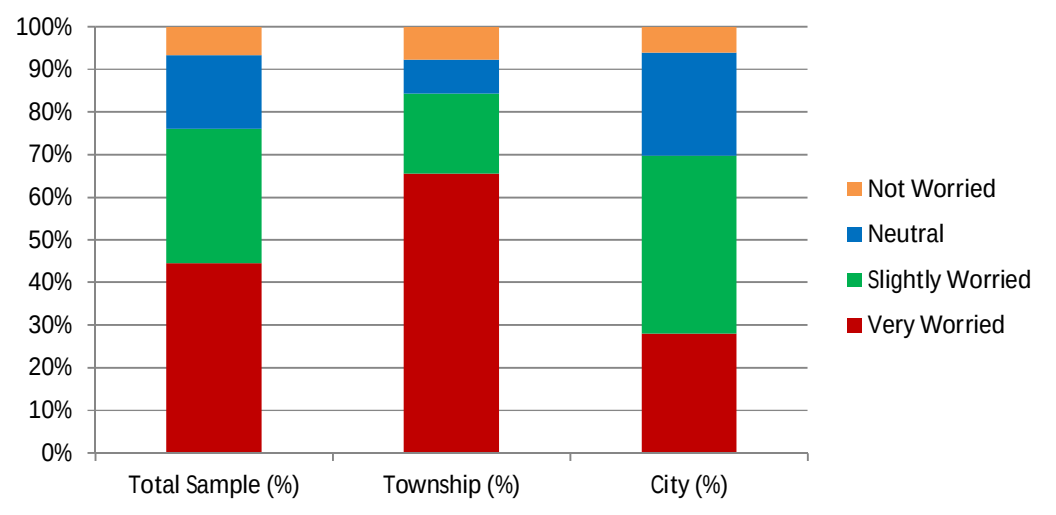


	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.426✻
Gr. 7 vs. Gr. 11	P < 0.986	0.04
Male vs. Female	P < 0.05♀	0.13◊

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice.

Table 2: School students concerns around waste volumes generated in their local environment

Q4a. To what extent are you worried about the volumes of waste generated in your School?				
	Very Worried	Slightly Worried	Neutral	Not Worried
Total Sample (%)	44.5	31.6	17.1	6.8
Township (%)	65.7	18.8	7.8	7.8
City (%)	28.1	41.6	24.3	6.0

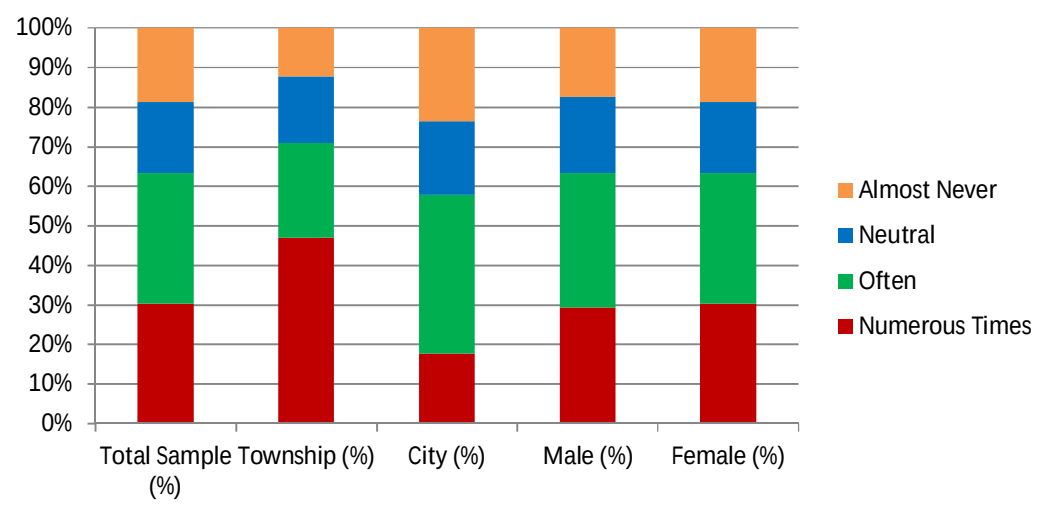


	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.39✻
Gr. 7 vs. Gr. 11	P < 0.116	0.09
Male vs. Female	P < 0.156	0.09

♀ Significantly different ✻Significant in Practice

Table 3: Students' frequency of concern with how they consider the impact of waste on the environment.

Q13a: How often do you think of waste and the impact it can have on the environment?				
	Numerous Times	Often	Neutral	Almost Never
Total Sample (%)	30.3	33.2	17.9	18.7
Township (%)	46.9	23.9	16.8	12.3
City (%)	17.6	40.2	18.6	23.6
Male (%)	29.3	34.1	19.2	17.4
Female (%)	30.3	33.2	17.9	18.7

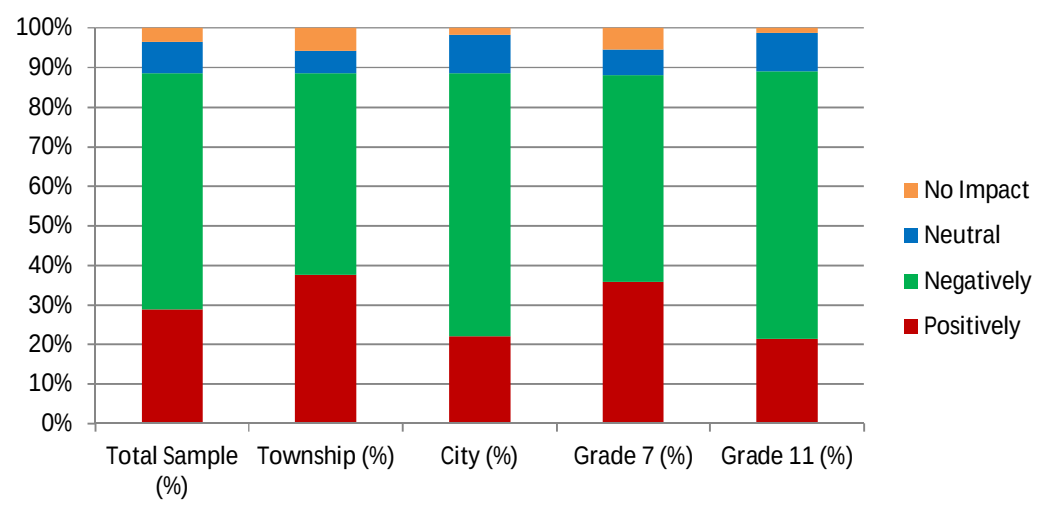


	Pearson Chi	Phi
Township vs. City	P < 0.05♀	0.34✻
Grade 7 vs. Grade 11	P < 0.59	0.06
Male vs. Female	P < 0.03♀	0.12◊

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice.

Table 4: Students' recognition of impact on their country as a result of poor waste management.

Q3a: How do you think poor waste management can impact the future of South Africa?				
	Positively	Negatively	Neutral	No Impact
Total Sample (%)	28.8	59.7	7.9	3.5
Township (%)	37.5	51.1	5.5	5.8
City (%)	22.1	66.4	9.8	1.8
Grade 7 (%)	35.9	52.2	6.4	5.5
Grade 11 (%)	21.4	67.6	9.5	1.4

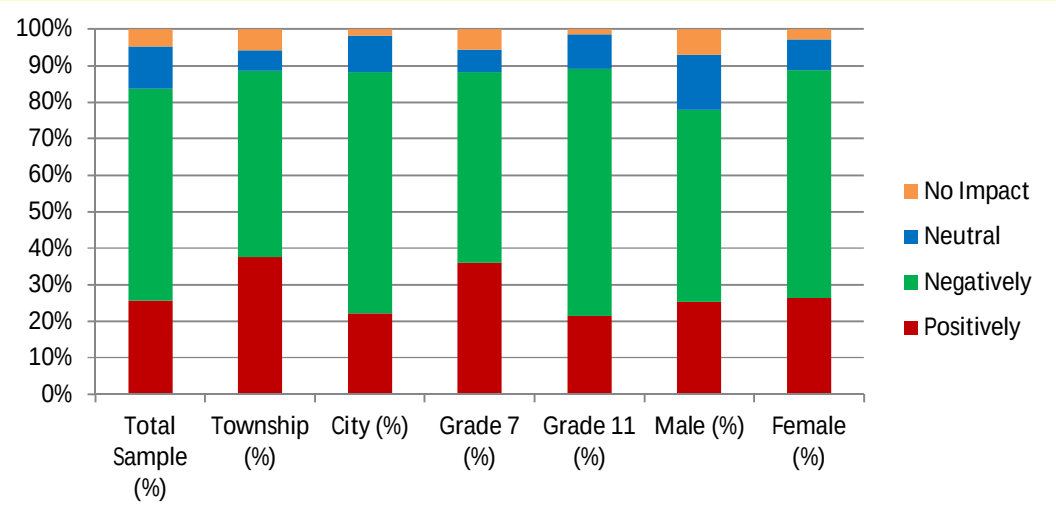


	Pearson Chi	Phi
Township vs. City	P < 0.05♀	0.22✻
Grade 7 vs. Grade 11	P < 0.05♀	0.21✻
Male vs. Female	P < 0.12	0.09

♀ Significantly different ✻Significant in Practice

Table 5: Students' recognition of impact on the individual as a result of poor waste management.

Q15a: How do you think poor waste management can impact your own personal future?	Positively	Negatively	Neutral	No Impact
Total Sample (%)	25.8	57.9	11.6	4.7
Township (%)	37.5	51.1	5.5	5.8
City (%)	22.1	66.4	9.8	1.8
Grade 7 (%)	35.9	52.2	6.4	5.5
Grade 11 (%)	21.4	67.6	9.5	1.4
Male (%)	25.4	52.5	15.0	7.1
Female (%)	26.3	62.6	8.4	2.7

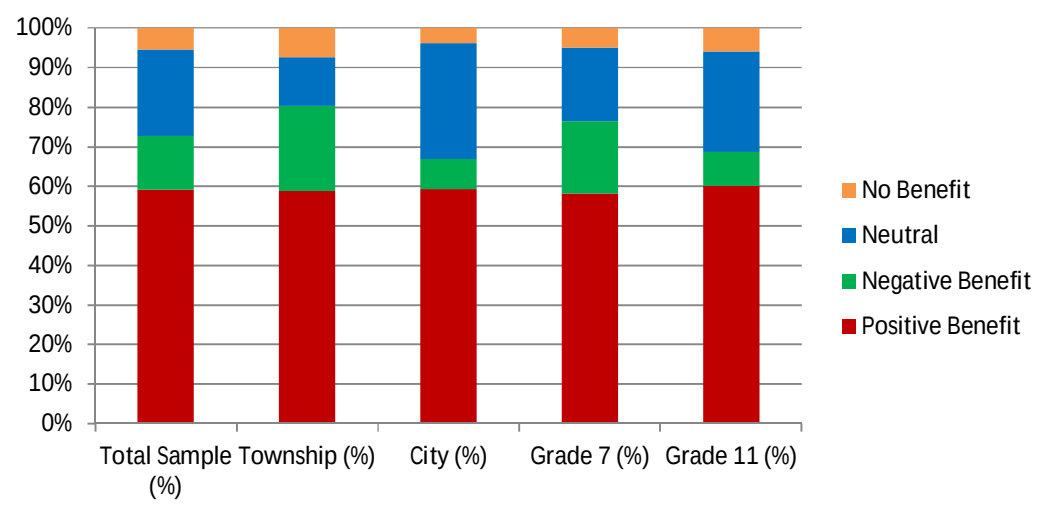


	Pearson Chi	Phi
Township vs. City	P < 0.05♀	0.21✻
Grade 7 vs. Grade 11	P < 0.05♀	0.16◊
Male vs. Female	P < 0.05♀	0.16◊

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice.

Table 6: Students' perceived benefit from good waste management practices.

Q16a: How do you perceive you will benefit from good waste management?	Positive Benefit	Negative Benefit	Neutral	No Benefit
Total Sample (%)	59.1	13.5	21.9	5.4
Township (%)	58.9	21.4	12.3	7.4
City (%)	59.3	7.6	29.2	3.9
Grade 7 (%)	58.3	18.2	18.5	5.0
Grade 11 (%)	60.0	8.7	25.4	5.9



	Pearson Chi	Phi (Significance in Practise)
Township vs. City	P < 0.05♀	0.32✻
Grade 7 vs. Grade 11	P < 0.05♀	0.15◊
Male vs. Female	P < 0.08	0.09

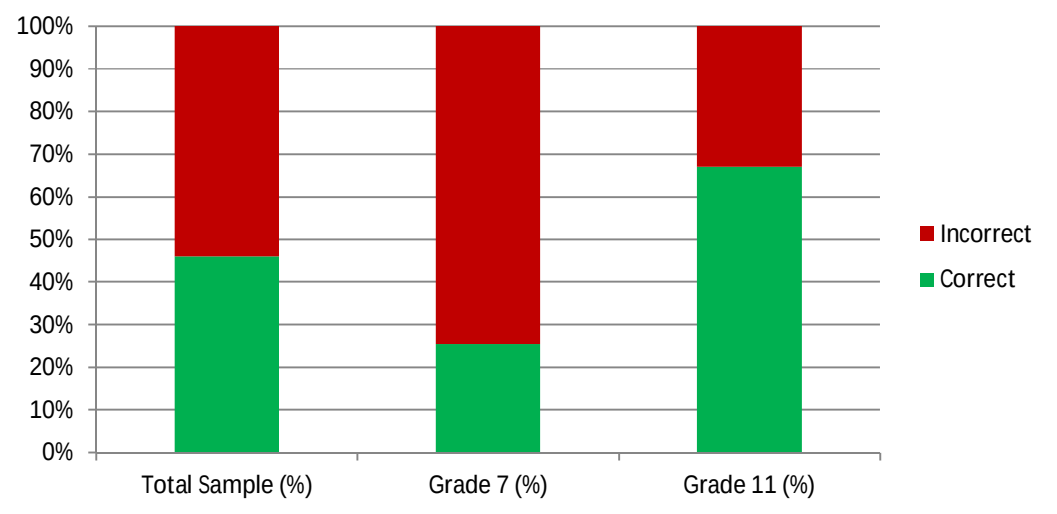
♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice.

II. Knowledge of students for waste and waste management in South Africa

Table 7: A school student's knowledge that mine waste is the largest waste volume generated in South Africa.

Q1k: Which type of Waste is generated in the largest volumes in South Africa?

Answer options	Agriculture	Mining (Correct)	Medical	Food	Petrochemical
		Correct		Incorrect	
Total Sample (%)		46.0		54.0	
Grade 7 (%)		25.4		74.6	
Grade 11 (%)		67.0		33.0	

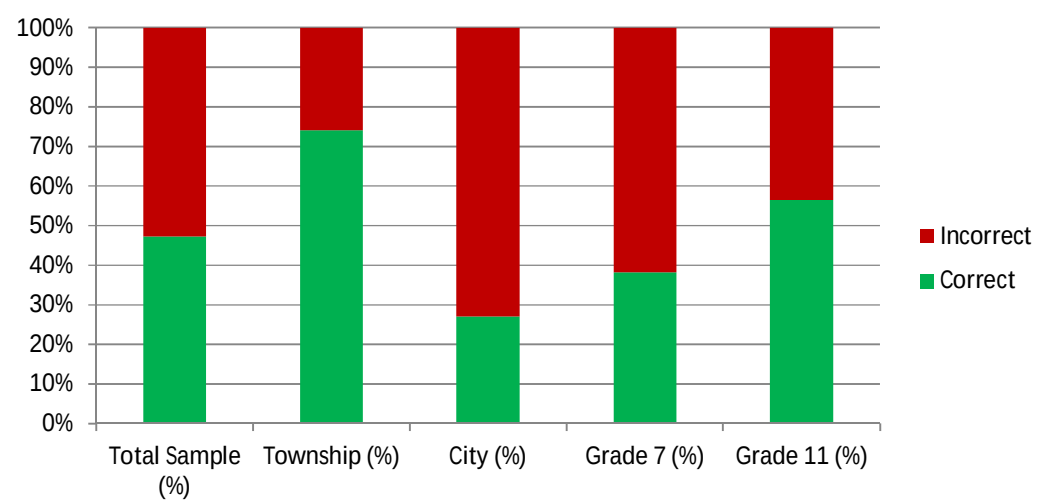


	Pearson Chi	Phi
Township vs. City	P<0.06	0.07
Grade 7 vs. Grade 11	P<0.05♀	0.41✻
Male vs. Female	P<0.07	0.07

♀ Significantly different ✻Significant in Practice

Table 8: A school student's awareness that the South African Government has an integrated waste management plan.

Q2k: In your opinion does the South African Government have an integrated waste management plan?		
Answer options	Yes (Correct)	No
	Correct	Incorrect
Total Sample (%)	47.3	52.7
Township (%)	74.1	25.9
City (%)	27.0	73.0
Grade 7 (%)	38.1	61.9
Grade 11 (%)	56.6	43.4



	Pearson Chi	Phi
Township vs. City	P<0.05♀	0.47✻
Grade 7 vs. Grade 11	P<0.05♀	0.19◊
Male vs. Female	P<0.09	0.07

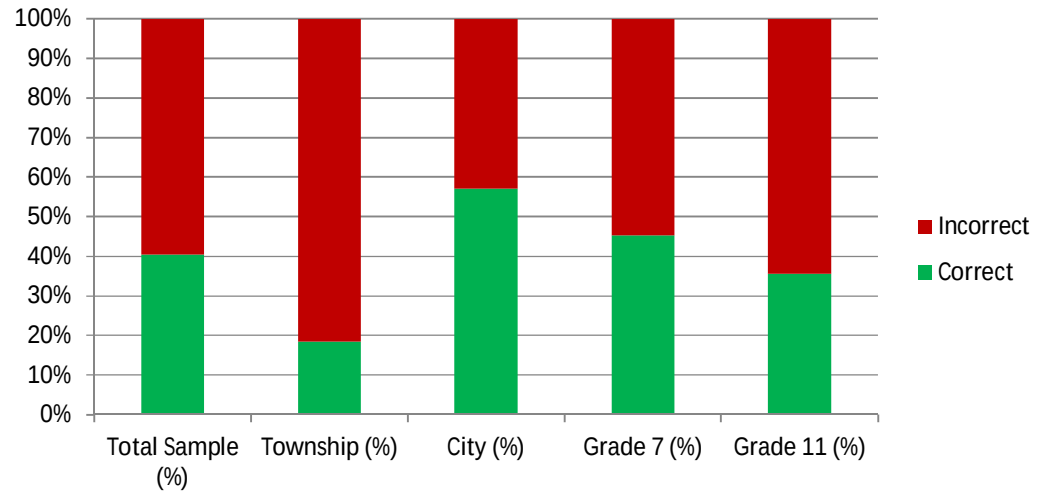
♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice.

Table 9: A school student's knowledge of the concept of waste hierarchy.

Q3k: Which one of the following actions is most favoured option in the concept of waste hierarchy?						
Answer options	Disposal	Energy Recovery	Recycle	Reuse	Minimize	Prevent (Correct)
		Correct			Incorrect	
Total Sample (%)		3.9			96.1	
		Pearson Chi			Phi	
Township vs. City		P<0.06			0.07	
Grade 7 vs. Grade 11		P<0.23			0.05	
Male vs. Female		P<0.99			0.05	

Table 10: Establishing the school student's knowledge that various wastes are handled differently for a reason.

Q4k: Why is polystyrene counted and handled separately in waste clean-up?					
Answer options	Floats on water	Toxic and breaks into smaller particles (Correct)	Different colour	Lighter than paper	Blown around by the wind
		Correct		Incorrect	
Total Sample (%)		40.4		59.6	
Township (%)		18.4		81.6	
City (%)		57.1		42.9	
Grade 7 (%)		45.3		54.7	
Grade 11 (%)		35.5		64.5	

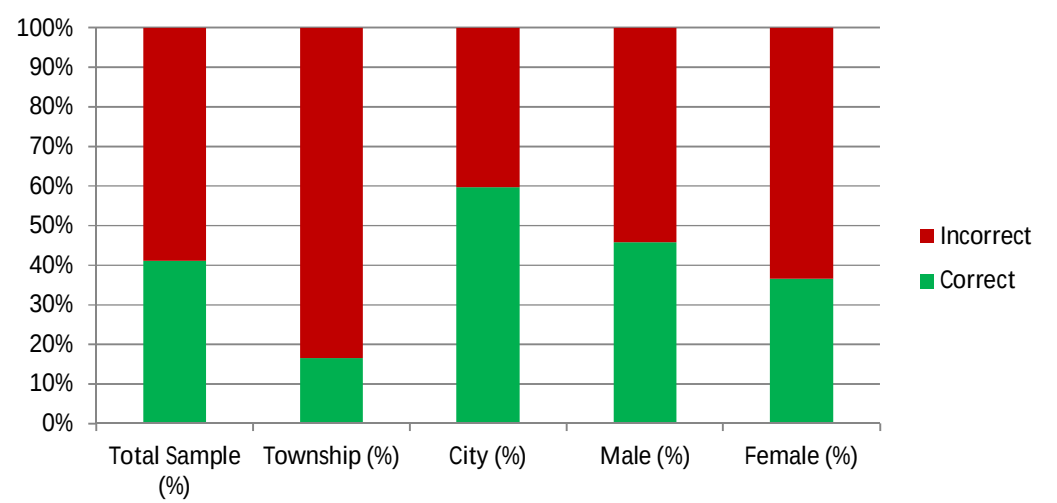


	Pearson Chi	Phi
Township vs. City	P<0.05♀	0.39✻
Grade 7 vs. Grade 11	P<0.05♀	0.10◊
Male vs. Female	P<0.534	0.02

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice.

Table 11: A school student's understanding that waste that can be effectively recycled wit glass as an example.

Q5k: How many times can glass be recycled?					
Answer options	Once	Ten times	Fifty times	Indefinitely (Correct)	Cannot be recycled
		Correct		Incorrect	
Total Sample (%)		41.1		58.9	
Township (%)		16.5		83.5	
City (%)		59.8		40.2	
Male (%)		45.7		54.3	
Female (%)		36.6		63.4	



	Pearson Chi	Phi
Township vs. City	P<0.05♀	0.44✻
Grade 7 vs. Grade 11	P<0.22	0.05
Male vs. Female	P<0.01♀	0.10◊

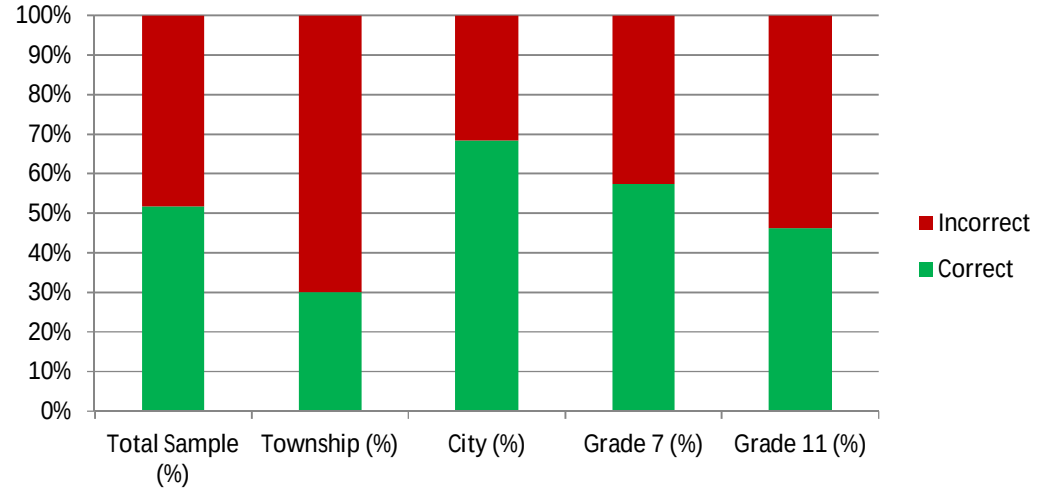
♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice.

Table 12: A school student's knowledge on some aspects of waste recycling

6k: How long does it (approximately) take to recycle an aluminium can?					
Answer options	Seven Days	One Month	Two Months (Correct)	Six Months	One year
		Correct		Incorrect	
Total Sample (%)		9.8		90.2	
		Pearson Chi		Phi	
Township vs. City		P<0.33		0.04	
Grade 7 vs. Grade 11		P<0.36		0.03	
Male vs. Female		P<0.17		0.05	

Table 13: A school student's understanding that poor and ineffective waste management have a negative impact on the environment.

Q7k: What are the effects of waste disposal to the earth?					
Answer options	Oxygen Trees and natural resources are wasted to make space for landfill waste	Contamination of soil	Contamination of water	Contamination of atmosphere	Al of the above (Correct)
	Correct			Incorrect	
Total Sample (%)	51.9			48.1	
Township (%)	30.1			69.9	
City (%)	68.4			31.6	
Grade 7 (%)	57.5			42.5	
Grade 11 (%)	46.2			53.8	

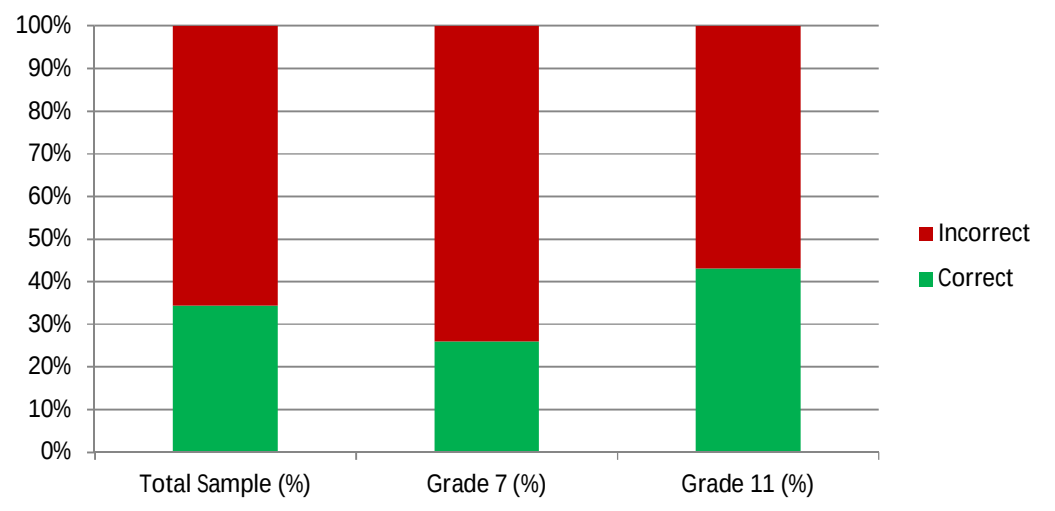


	Pearson Chi	Phi
Township vs. City	P<0.05♀	0.38✻
Grade 7 vs. Grade 11	P<0.05♀	0.11◊
Male vs. Female	P<0.85	0.01

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice.

Table 14: A school student's understanding that different wastes must be segregated and managed separately.

Q8k: In what waste group does household garbage belong?					
Answer options	Hazardous waste	Nuclear waste	Non Hazardous waste (Correct)	Electronic waste	Special waste
	Correct			Incorrect	
Total Sample (%)	34.4			65.6	
Grade 7 (%)	26.0			74.0	
Grade 11 (%)	43.1			56.9	



	Pearson Chi	Phi
Township vs. City	P<0.48	0.03
Grade 7 vs. Grade 11	P<0.05♀	0.18◊
Male vs. Female	P<0.54	0.02

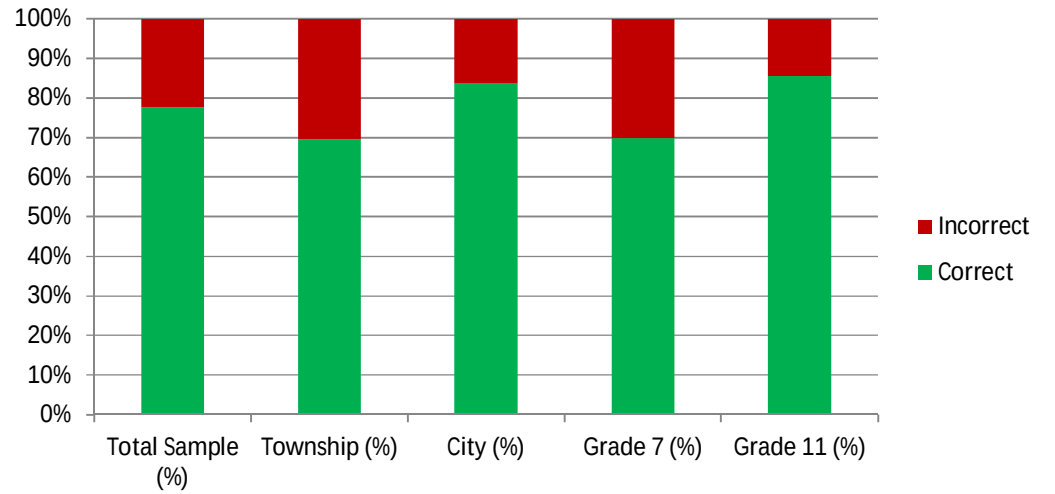
♀ Significantly different; ◊ Statistical Significant difference, but Phi significance to low for justification in practice.

Table 15: A school student's understanding of waste terminology.

Q9k: What is another term for burning waste?					
Answer options	Recycling	Sweeping	Incineration (correct)	Grading	Disposal
		Correct		Incorrect	
Total Sample (%)		58.3		41.7	
		Pearson Chi		Phi	
Township vs. City		P<0.07		0.07	
Grade 7 vs. Grade 11		P<0.22		0.05	
Male vs. Female		P<0.57		0.02	

Table 16: A School student's understanding why different wastes must be segregated and managed separately.

Q10k: Why is polystyrene counted and handled separately in waste clean-up?					
Answer options	Floats on water	Toxic and breaks into smaller particles (Correct)	Different colour	Lighter than paper	Blown around by the wind
		Correct		Incorrect	
Total Sample (%)		77.7		22.3	
Township (%)		69.6		30.4	
City (%)		83.8		16.2	
Grade 7 (%)		69.9		30.1	
Grade 11 (%)		85.6		14.4	



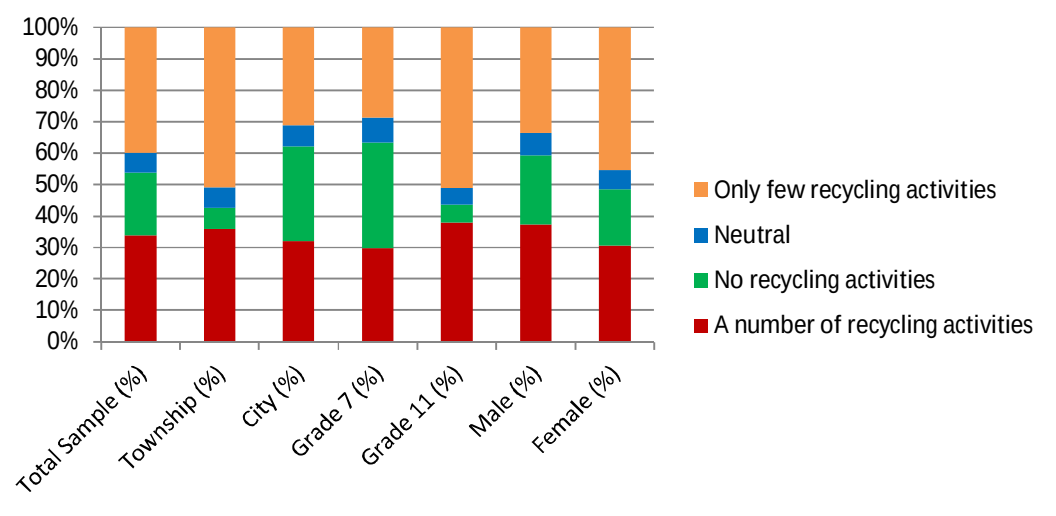
	Pearson Chi	Phi
Township vs. City	P<0.05♀	0.17◊
Grade 7 vs. Grade 11	P<0.05♀	0.19◊
Male vs. Female	P<0.53	0.06

♀ Significantly different ; ◊ Statistical Significant difference, but Phi significance to low for justification in practice.

III. Practice of students for waste and waste management

Table 17: Recycling activities at school

Q5a: Are there any waste recycling programs or activities in your school?				
	A number of recycling activities	No recycling activities	Neutral	Only few recycling activities
Total Sample (%)	33.8	19.9	6.6	39.7
Township (%)	35.9	6.8	6.5	50.8
City (%)	32.1	30.1	6.8	31.1
Grade 7 (%)	29.8	33.4	8.0	28.7
Grade 11 (%)	37.9	5.8	5.2	51.2
Male (%)	37.2	22.1	7.1	33.6
Female (%)	30.6	17.9	6.2	45.3



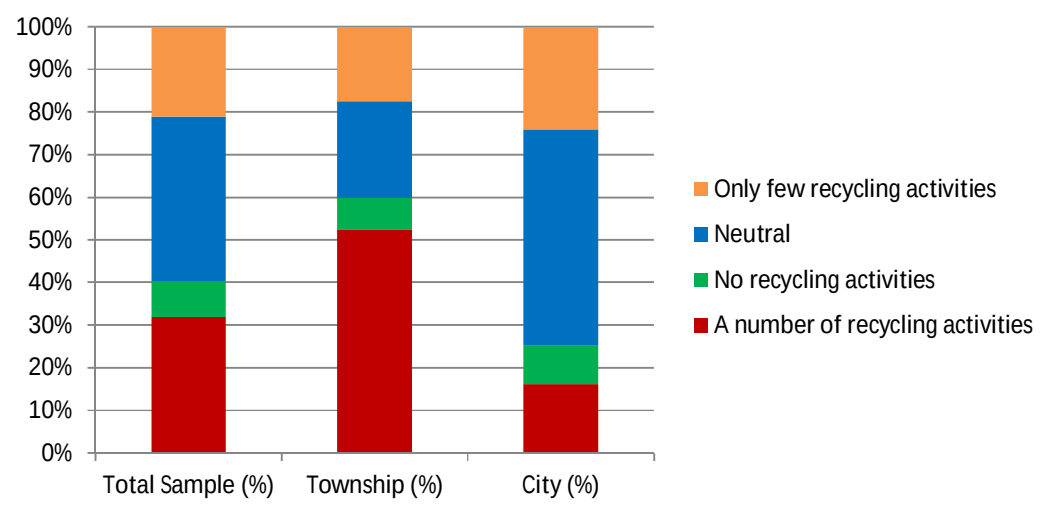
	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.3✻
Gr. 7 vs. Gr. 11	P < 0.05♀	0.4✻
Male vs. Female	P < 0.05♀	0.12◊

♀ Significantly different ✻Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice.

Table 18: Waste recycling programs in the neighbourhood

Q8a: Are there any waste recycling programs or activities where you live?

	A number of recycling activities	No recycling activities	Neutral	Only few recycling activities
Total Sample (%)	31.9	8.5	38.4	21.2
Township (%)	52.4	7.4	22.7	17.5
City (%)	16.0	9.3	50.6	24.1

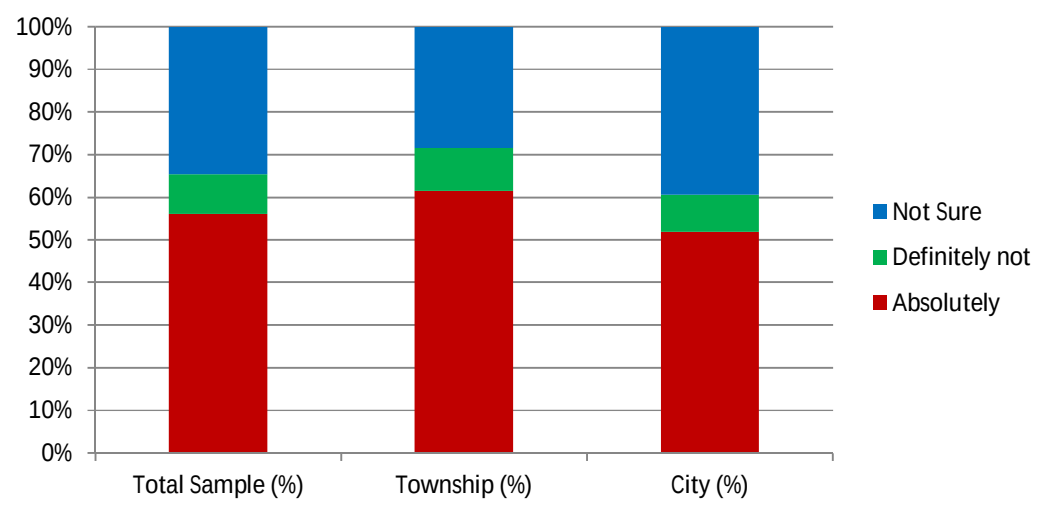


	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.41✻
Gr. 7 vs. Gr. 11	P < 0.15	0.09
Male vs. Female	P < 0.22	0.08

♀ Significantly different ✻Significant in Practice

Table 19: A school student's willingness to be part of the waste recycling activities in their school.

Q12a: Would you want to be part of a waste recycling initiative in your school or community?			
	Absolutely	Definitely not	Not Sure
Total Sample (%)	56.1	9.2	34.7
Township (%)	61.5	10.0	28.5
City (%)	52.0	8.6	39.5

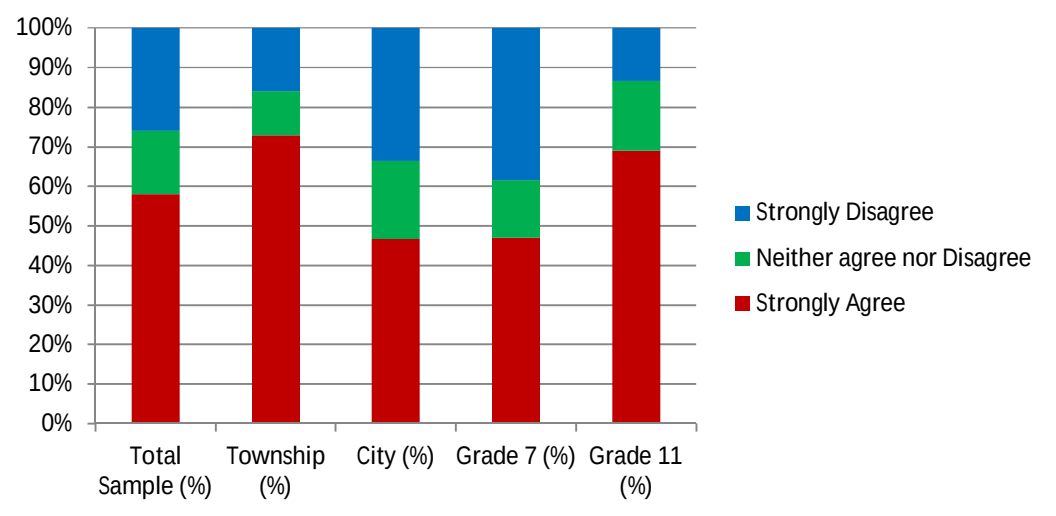


	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.11◊
Gr. 7 vs. Gr. 11	P < 0.87	0.02
Male vs. Female	P < 0.18	0.07

♀ Significantly different; ◊ Statistical Significant difference, but Phi significance to low for justification in practice.

Table 20: Promotion of waste minimization in schools.

Q3p: Waste minimization is promoted in your school?	Strongly Agree	Neither agree nor Disagree	Strongly Disagree
Total Sample (%)	57.9	16.2	25.9
Township (%)	72.8	11.3	15.9
City (%)	46.6	19.9	33.5
Grade 7 (%)	47.0	14.6	38.4
Grade 11 (%)	69.1	17.7	13.3

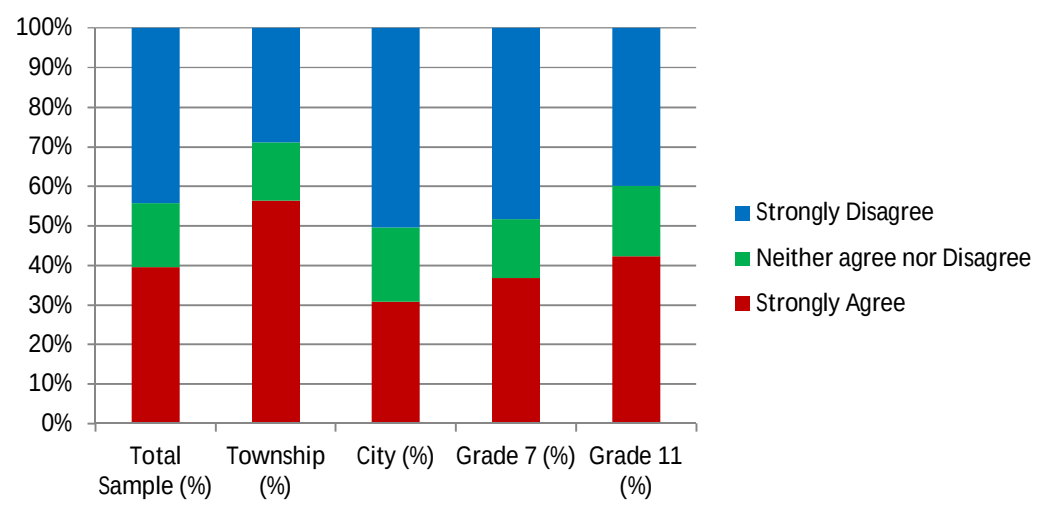


	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.30✻
Gr. 7 vs. Gr. 11	P < 0.05♀	0.30✻
Male vs. Female	P < 0.47	0.07

♀ Significantly different ✻Significant in Practice

Table 21: Waste segregation and recycling at home.

Q4p: Do you sort and recycle your waste at home ?	Strongly Agree	Neither agree nor Disagree	Strongly Disagree
Total Sample (%)	39.5	16.3	44.2
Township (%)	50.8	13.3	25.9
City (%)	30.9	18.6	50.5
Grade 7 (%)	36.8	14.9	48.3
Grade 11 (%)	42.3	17.7	40.0

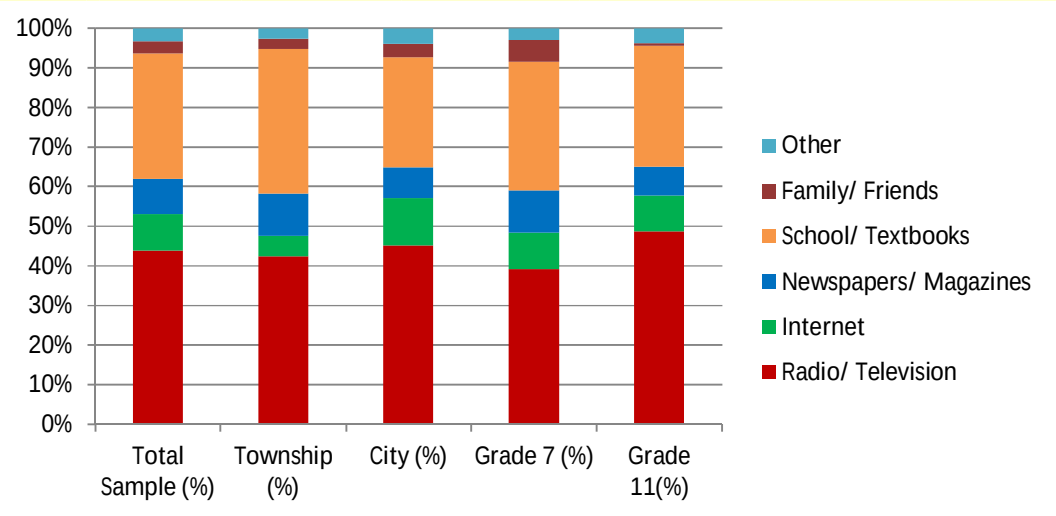


	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.31✲
Gr. 7 vs. Gr. 11	P < 0.05♀	0.15◊
Male vs. Female	P < 0.34	0.08

♀ Significantly different ✲Significant in Practice
◊ Statistical Significant difference, but Phi significance to low for justification in practice.

Table 22: What source of information on waste management is most prevalent for students?

Q11a: Where do you learn most about waste and waste management?	Radio/ Television	Internet	Newspapers/ Magazines	School/ Textbooks	Family/ Friends	Other
Total Sample (%)	43.9	9.1	9.1	31.5	3.1	3.3
Township (%)	42.4	5.2	10.7	36.6	2.6	2.6
City (%)	45.1	12.0	7.8	27.7	3.4	3.9
Grade 7 (%)	39.2	9.1	10.8	32.3	5.5	3.0
Grade 11(%)	48.7	9.0	7.3	30.7	.6	3.7

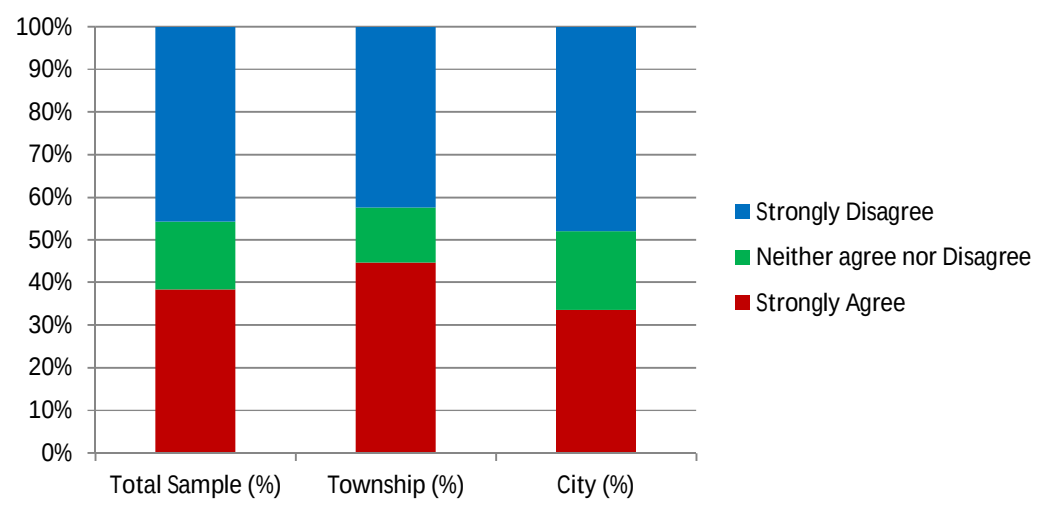


	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.15◊
Gr. 7 vs. Gr. 11	P < 0.05♀	0.17◊
Male vs. Female	P < 0.66	0.07

♀ Significantly different ; ◊ Statistical Significant difference, but Phi significance to low for justification in practice.

Table 23: A student's attitude towards waste management and their willingness to contribute.

Q5p: You will donate some of your pocket money towards waste management?	Strongly Agree	Neither agree nor Disagree	Strongly Disagree
Total Sample (%)	38.3	16.0	45.6
Township (%)	44.7	12.9	42.4
City (%)	33.6	18.4	48.0



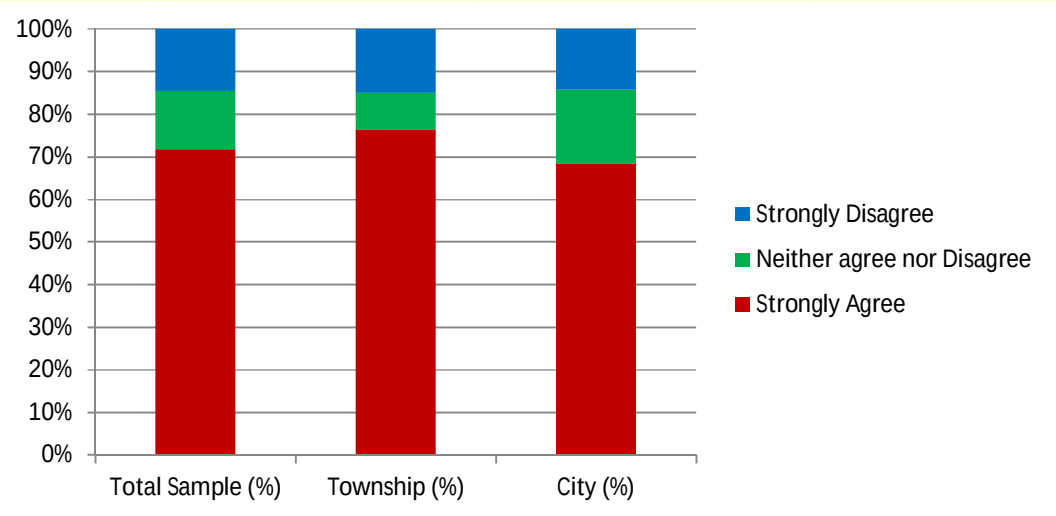
	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.19◊
Gr. 7 vs. Gr. 11	P < 0.24	0.09
Male vs. Female	P < 0.67	0.06

♀ Significantly different ; ◊ Statistical Significant difference, but Phi significance to low for justification in practice.

Table 24: A student's attitude towards the importance waste management and their willingness to convince their peers.

Q6p: You will try and persuade your friends that waste management is important to protect the environment?

	Strongly Agree	Neither agree nor Disagree	Strongly Disagree
Total Sample (%)	71.8	13.7	14.5
Township (%)	76.4	8.7	14.9
City (%)	68.4	17.4	14.2



	Pearson Chi	Phi (Significance in practise)
Township vs. City	P < 0.05♀	0.27✻
Gr. 7 vs. Gr. 11	P < 0.07	0.11
Male vs. Female	P < 0.19	0.09

♀ Significantly different ✻Significant in Practice