Waste Management Knowledge, its Production, Recontextualisation and Circulation in Expanded Public Works Programme (EPWP) Training Programmes

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by

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DEDICATION

This study is dedicated to my late parents: Nomvula Henrietta Giqwa; Joanna Nombuyekezo Giqwa and Cordingley Samuel Giqwa.
I am what I am today because of your sacrifices and love.

I also dedicate this work to my late grandparents: Thandiwe and Baker Giqwa who loved me unconditionally and stayed with me throughout my early years of life.

Finally, I dedicate it also to my late sister, Kholisa Ntomboxolo Giqwa,
who kept saying to me “you still have energy, you can reach the skies”.

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ABSTRACT

This study set out to investigate the structuring, recontextualisation and circulation of waste management knowledge in the South African environmental Expanded Public Works Programme (EPWP) Waste Management Projects. In this thesis these projects also referred to as the Working on Waste (WoW) programme or focus area within the Environmental Protection and Infrastructure Programme (EPIP) hosted by the National Department of Environmental Affairs. Expanded Public Work Programmes are a strategy used by governments to address unemployment and in South Africa; the programmes also seek to address a need for skills development. In this study, the focus is on EPWP ***waste management*** knowledge, training programmes and activities only.

With waste management knowledge as the core interest, the focus of the investigation was on knowledge circulation of waste management via informal (participation in the project) and formal training of workers at Level 2 National Qualifications Framework (NQF). The study started by firstly investigating what waste management knowledge is produced in the Field of Production via scientific research and policy. It then studied how this waste management knowledge is recontextualised into qualifications and skills programmes designed in the official recontextualising field and learning materials and training programmes designed and offered in the professional recontextualising field. The study also focused on the knowledge of workers and their experience of training in the EPWP workplaces, with an emphasis on rural workplaces. This is where the Department of Environmental Affairs (DEA) is placing emphasis on training for job creation, empowerment and skills development, and it is also where a number of EPWP Working on Waste programmes are being implemented.

The aim was also to develop an understanding of how knowledge circulates amongst learners in training sessions and in workplaces. To do this, I drew on Bernstein's theory of the pedagogical device which provides theoretical lenses and a language of description to explain how knowledge is recontextualised from the field of production to the field of reproduction. To investigate the structuring of this knowledge by official and pedagogical recontextualisers, I drew on the work of Maton, who offers a Legitimation Code Theory to explain the principles structuring knowledge, of which I used specialisation and semantics (two of his suite of knowledge structuring principles) for analysis. The questions that guided the study throughout were:

1. What is the structure of legitimate knowledge and knowers in waste management?
2. What are the underlying principles underpinning knowledge and knowers in waste management?
3. How is the knowledge recontextualised in waste management training qualifications, documents and manuals for worker training at NQF Level 2?
4. How is the knowledge reproduced and evaluated in the waste management EPWP training activities (formal) and workplaces (informal)?
5. How does waste management knowledge circulate amongst the workers in the EPWP training activities and workplaces?

For this study I used the case study method, focusing only on one field or DEA EPWP focus area (waste

management) and one programme (EPWP Working on Waste), looking in more depth at two cases (two similar types of projects) within the EPWP Working on Waste programme, though they are situated in different areas and though I could only carry through observations of actual workplace training in one of the two sites due to contextual circumstances. The first project was situated in the Amathole District Municipality while the second one was situated in the Chris Hani District Municipality, both of which are in the rural towns of the former Transkei region in the Eastern Cape, South Africa. This area has been at the forefront in accessing funding for these projects due to the level of poverty surrounding these towns and the inability of the local government sphere to deliver on its mandate in the region. Data was collected through document analysis, questionnaires, interviews and observations. Documents analysed were research documents produced by researchers at the level of production as well as legal frameworks guiding waste management processes in this country. Qualifications and Unit Standards at Level 2, as well as training materials designed by providers were analysed. Training in one of the projects was observed and workers in both sites were interviewed twice.

The main finding of the study is that waste management knowledge is characterised by inter-disciplinarity and a strong epistemic relation which emphasises procedural and technical forms of knowledge. The study found that the knowledge constructed in the field, as well as the policies, qualifications and training programmes are all consequently characterised by a strong epistemic code (ER+) and a weak social relations code (SR-). The study also identified a 'code clash' with the knowledge of workers in rural towns whose knowledge and experience of waste management was found to reflect a strong social relation (SR+) and weak epistemic code (ER-), a pattern which was traced back to a similar code in waste management knowledge at home and school (i.e. workers' prior knowledge and learning experiences). This created difficulties for the trainers who sought to use strategies of descending from the abstract to the concrete in various 'descending' semantic waves that tended to move from high levels of semantic density (SD+) to lower levels of semantic density (SD-) as the training provider sought to contextualise a range of concepts. This was the main strategy identified for mediating waste management knowledge reflecting a dominant pattern of SD+/SG- to SD-/SG+ (with SG meaning semantic gravity). This shows that the trainer seldom started mediating concepts from the basis of workers' prior knowledge and experience and observations showed little responsiveness from workers resulting from this strategy. Despite this, the study found that workers did develop an improved understanding of specialised waste management knowledge over time, especially through observing and doing more complex tasks in the workplace. The study offers a model for addressing the pedagogical difficulty identified around the code clash, and suggests that further attention needs to be given to 'ascending' from the concrete to the abstract in pedagogical practices. The study also pointed to the need for a more inclusive knowledge framework for waste management training, especially in the field of recontextualisation (both the official and pedagogical recontextualisation fields) to extend possibilities for workers to learn more about economic potential and access routes into more sustainable jobs. It identifies the need for a more systemic approach to waste management in rural towns and municipalities, improved compliance and also proposes that better waste management practices are modelled to avoid performative contradictions between the knowledge promoted in the field of production and the official and pedagogical recontextualising fields and the field of reproduction, where

workers are learning this knowledge via a mix of accredited training and exposure to participation in waste management practices.

This study contributes to new knowledge in that it offers an epistemically grounded and theorised pedagogical process model for Level 2 Waste Management Training (in the EPWP programmes, but potentially also more broadly) that accords with the need for a strong epistemic relation code (ER+) embodied in the need for learning scientific and technical waste management knowledge and procedures. It also addresses workers' needs for greater epistemic access and participation in knowledge building and application of waste management knowledge in praxis as per the purpose of the EPWP training programmes, thereby potentially opening up more sustainable learning pathways for them out of poverty through the EPWP training opportunities.

The study has pointed to key areas for further research, including further research on the proposed model, further research into Level 2 pedagogical practices and further research into the foundations of waste management learning in schools. Most of the workers who were participating in the training in the EPWP programmes were educated at above Level 2 before participating in the projects, yet their knowledge and experience of waste management was mostly based on everyday knowledge, pointing to an absence of adequate waste management education in schools in rural contexts in South Africa.

The study has also made various recommendations for improving waste management education and training at Level 2 in EPWP programmes in rural areas in particular (but potentially also more widely), notably the need to develop a more inclusive knowledge framework that includes historical and economic knowledge more explicitly at all levels of the recontextualisation process; improved pedagogical and assessment practices that take better account of learners knowledge and experiences in knowledge building processes; and giving attention to structural and systemic approaches to waste management in rural areas to avoid performative contradictions that arise between the knowledge being promoted in the field of production and the field of reproduction and the actual context of waste management.

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ACRONYMS

AC	Assessment Criteria
ACR	Assessment Criteria Range
ANC	African National Congress
CBD	Central Business District
CONNEPP	Consultative National Environmental Policy Process
COSATU	Congress of South African Trade Unions
CSIR	Council of Science and Industrial Research
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DHET	Department of Higher Education and Training
DBE	Department of Basic Education
DoL	Department of Labour
DST	Department of Science and Technology
EEK	Essential Embedded Knowledge
EGS	Employment Guarantee Scheme
EPIP	Environmental Protection and Infrastructure Programme/ Projects
EPWP	Expanded Public works Programme
ER	Epistemic Relation
LCT	Legitimate Code Theory
LGSETA	Local Government Sector Education and Training Authority
NEMA	National Environmental Management Act 107 of 1998
NEMWA	National Environmental Management Waste Act
NRM N	atural Resource Management
NQF	National Qualifications Framework
ORF	Official Recontextualising Field
P1	Provider 1
P2	Provider 2
PFMA	Public Finance Management Act
PRF	Pedagogic Recontextualising Field
QCTO	Quality Council of Trade and Occupations
RDP	Reconstruction and Development Programme
SADC	Southern African Development Community
SAQA	South African Qualifications Authority
SATN	South African Technology Network
SD	Semantic Density
SETA	Sector Education and Training Authority
SG	Semantic Gravity
SGB	Standard Generating Body
SO	Specific Outcome
SR	Social Relation
UN	United Nations
WM	Waste Management
WoW	Working on Waste

Chapter 1:

Introduction to the Study

1.1 INTRODUCTION

This study originates from my experiences of working with skills development and the environmental activities of the South African Expanded Public Works Programme (EPWP) within the Department of Environmental Affairs (DEA). The Expanded Public Works Programme is a strategy used by governments to address unemployment and illiteracy among the citizens. EPWP programmes provide workers with wages that are not too high in order not to compete with the market place. The purpose is to cater for the unemployed and prevent the programme from drawing workers away from the jobs already offered by the market places. A crucial issue for public works programmes has been whether they can function "as transformative social protection by achieving a threshold of assets and skills that will enable employment" (Phillips, 2004, p. 3).

In post-apartheid South Africa there has been an ongoing demand for employment for semi-skilled and unskilled workers and EPWP was therefore used as a tool to address the low skills and unemployment. It creates work opportunities for the unemployed while ensuring that workers gain skills, training, and so increase their capacity to earn an income in the future. They also provide access to training in a way that better equips the workforce to take up opportunities that are more skilled when projects have come to an end (Phillips, 2004, p. 3).

The EPWP, especially its focus on skills development and the creation of employment, forms the core contextual setting of this study. This study concentrates on environmental EPWP programmes, which align with the mandate of the Department of Environmental Affairs where I work with special focus on waste management. It also responds to the question of "knowledge" which lies at the heart of debates in South African Education, Training and Development today (Muller, 2004, p. 17). Gaps in literacy levels and a history of poor quality education has led to government putting in place policies, government initiatives and strategies to support the education and training of previously disadvantaged groups in workplaces. This study therefore focuses on knowledge of waste management in the context of workplace-based skills development programmes within waste management EPWP projects. In this study these projects are commonly referred to as the Working on Waste (WoW) programmes of the EPWP.

The chapter commences with the discussion of the broader historical and contextual background of the study, the origins of and the establishment of EPWP, as well as the evolution of waste management as a field of concern in the world. One of the pillars of EPWP is creation of employment/ job creation which brings workplace practices and workplace learning into focus in the chapter. The chapter also outlines the research questions and gives an overview of the chapters in the thesis.

1.2 BROADER HISTORICAL AND CONTEXTUAL BACKGROUND INFLUENCING THIS STUDY

1.2.1 Policy Background and Research Problem

In 1977 the government of South Africa appointed the Wiehahn Commission to investigate labour and training legislations in workplaces in South Africa. The commission found that the legislative structure for industrial training was not synergistic. It was characterised by overlaps, gaps, and a lack of standardisation and coordination (Wiehahn, 1977; Kraak, 2004).

This situation of ongoing neglect of worker education and training continued under apartheid. In 1994 with the change to a post-apartheid, democratic state, workplace learning and youth unemployment were identified as critical challenges facing South Africa by the Reconstruction and Development Programme (RDP) document of 1994, which was the African National Congress (ANC)'s policy framework for post-apartheid governance (ANC, 1994). In response to the issues raised, the Reconstruction and Development Programme document recommended job creation through a Public Works Programme (PWP) and an integrated qualifications framework to enable learners to progress to higher levels of education from any starting point. It emphasised that job creation should cater for women, youth and the disabled (ANC, 1994, p. 16). The South African Qualifications Act (SAQA) (South Africa, 1995) Skills Development Act (South Africa. Department of Labour [DoL], 1998) and later the revised National Qualifications Framework Act (South Africa, Department of Higher Education [DHET], 2008) are policies that have guided skills development and the development of education and training in workplaces in South Africa since 1994. In 2003, the Expanded Public Work Programme (EPWP) was established. The EPWP was established as a state-led strategy to alleviate unemployment and poverty. From an education and training perspective, the National Qualifications Framework (NQF) based on principles of equity, access, portability and redress was established (ibid.). Its intention is to enable access to those previously denied adequate

learning pathways. It was meant to include a significant programme on recognition of prior learning and to facilitate worker training and learning (South Africa. SAQA, 1995).

Key legislative acts associated with NQF mentioned in the previous paragraph brought a stronger focus on skills development into workplaces and also led to the establishment of the Sector Education and Training Authorities (SETAs) who are mainly responsible for quality management of workers' training. The main purpose of the Skills Development Act of 1998 (South Africa. DoL, 1998) is to develop the skills of South African workers, improve the life of workers, improve productivity in the workplace, encourage the workers to use the workforce as an active learning environment and to assist the unemployed to enter the world of work (South Africa. DoL, 1998, p. 4). To ensure quality, portability, and access, the Department of Labour whose mandate has more recently been shifted to the Department of Higher Education and Training (DHET) recommended that workers need to participate in training through learnerships and skills programmes (South Africa. DOL, 1998, p. 4). The legislation and structural make-up referred to above has sought to ensure quality of education and training in workplaces through a quality assurance system. Most recently, under the NQF Act of 2008, responsibility for quality assurance of workplace learning has been allocated to the Department of Higher Education and Training and its quality councils. Here the Quality Council for Trade and Occupations (QCTO) now governs all workplace training programmes and learnerships via the Sector Education and Training Authorities, including those offered by the Expanded Public Works Programme (EPWP).

While these structures have been put in place to govern the quality of workplace-based training and learning, little is known about the structure of knowledge in workplace-based learning programmes which fall under the governance ambit of the SETAs and the newly established QCTO. This means that little is known about the production, recontextualisation, reproduction and circulation of knowledge in this sphere of the education and training system, a problem which will be discussed in more depth in Chapter 2 of this research. In relation to environmental knowledge and how it circulates and is recontextualised amongst trainers and workers in the EPWP programmes, there is even less understanding. This is the research gap that this study seeks to address.

The lack of knowledge pointed to above has been confirmed by the Environmental Sector Skills Plan (ESSP) (South Africa. DEA, 2010a), which was an initiative of the Department of Environmental Affairs (DEA) in 2010 to assess supply and demand of skills in the

environmental sector (ibid.). The ESSP identified a neglect of environmental practices training for workers in South Africa at Levels 1-4 of the NQF, showing that very little attention had been given to knowledge and skills development at this level (ibid.). Waste Management was identified by the Environmental Sector Strategic Plan (2005-2013) as one of the priorities for environmental skills development at provincial and local government level, where up to 30 000 workers are employed in waste management and other environmental practices (South Africa. DEA, 2005 - 2013, p. 21)

This study specifically addresses the knowledge gap associated with how *waste management knowledge* is recontextualised, reproduced and/or circulated at workers' training levels in the EPWP programmes. It specifically researches knowledge structures and their underpinning principles at the level of production, recontextualisation, reproduction and circulation of knowledge in waste management workplace learning in the environmental Expanded Public Works Programme (see research questions in section 1.3.2 below). Internationally, the Expanded Public Works programme is termed the Public Works Programme. To provide further contextual insight into this enquiry, the origins and the development of the Public Works Programme, Expanded Public Works Programme as well as the evolution of waste management are discussed below.

1.2.2 Some International and National Perspectives of the Public Works Programme

1.2.2.1 Public Works Programmes in India

Public works programmes were introduced into India in the early 1970s. The first programme was called the Employment Guarantee Scheme (EGS). Its aim was to provide a guarantee of employment to all adults above 18 years who are willing to do unskilled manual work. It was totally financed by the state with an aim to improve household welfare in the short term through the provision of employment in the rural economy. It targeted the poor, young agricultural labour, and females with low levels of schooling who are households' heads and come from low income and low asset households. Mahendra (1996) argued that lower wages should be maintained in order to have wider coverage which would help the poor more compared to using a system of rationing with higher wages. A secondary effect of the EGS was that it contributed to the creation of rural assets. Its projects were related to soil conservation, land development, percolation tanks and roads. It was criticised for neglecting the creation of durable assets (Mahendra, 1996; McCutcheon & Taylor-Parkins, 2003).

The EGS was followed by the implementation of the Maharashtra Employment Guarantee Scheme in Maharashtra in 1979. Maharashtra is a semi-arid region in India with highly seasonal agriculture. It had two criteria which were to create productive assets and to be labour intensive. Maharashtra EGS projects were environmental as they included soil, water, land conservation works, afforestation, and food projects. There was a wage hike and the relatively affluent joined the programme. Participation decreased in 1988 as there was a drop in the number of days of employment per person (ibid.).

The Maharashtra EGS programme was followed by the National Rural Employment Guarantee Act (NREGA). Its goal was asset accumulation like the Maharashtra EGS. The workers were guaranteed 100 days of work per rural household per year to anyone able and willing to work at district-specific agricultural minimum wages. Only 10% of all workers benefited as they used contractors which preferred use of machinery over labour (McCutcheon & Taylor-Parkins, 2003). Evidence above points out that the higher the wage, the less the access of the poor to the programme as it attracted the skilled, and thus lower numbers of the poor benefit from the programme.

The National Rural Employment Guarantee Act (NREGA) programme was followed by the National Food for Work Programme (NFFWP) programme. It provided 150 struggling districts in India with additional supplementary food resources through public employment. Wages were paid in kind at a rate of 5kg of food grain per person per day. The programme was sponsored by central government and the district authorities were responsible for planning, execution, organisation, supervision and monitoring of the programme. However, most of the resources meant to target the poor were captured by the non-poor (McCutcheon & Taylor-Parkins, 2003). Not much is mentioned in the literature about training or learning processes associated with these public works programmes.

1.2.2.2 Public Works Programme in Argentina

In 2001 Argentina experienced a severe economic crisis with increases in unemployment and poverty which resulted in the establishment of a public works programme. It entailed an unconditional transfer of 150 pesos to an individual per month in return for work. Eligible for participation were household heads with dependants comprising of children below the age of 18 years old.

One of the challenges experienced in this programme was that it was difficult to verify the employment status of the applicants. Most of the jobs in Argentina were in the informal sector and it was therefore difficult for the programme to verify workers in the informal sector. Only the status of workers in the formal sector could be verified. Participants had to do 20 hours of community service or employment in a private company with a wage subsidy for six months. In this programme there was no form of training or skills development. It was a 'hand to mouth' programme with no reference to the future. The public works programme focused only on job creation and development of assets (McCutcheon & Taylor-Parkins, 2003).

1.2.2.3 Public Works Programmes in African countries other than South Africa

Public works Programmes in Africa have been implemented in 13 countries which include Malawi, Kenya, Mozambique, Botswana, Ghana, Mali, Morocco, Tunisia, Algeria, Senegal, Ethiopia, Zimbabwe, and Tanzania. However, there are few carefully recorded experiences of these programmes. Africa is faced with three main problems: food security, growing unemployment and poor infrastructure (Subbaro, 1997). The Public Works Programmes in African countries were seen to contribute to ensuring direct and sustainable poverty alleviation and to strengthening capacities for self-reliance. They were also used to address problems of famine (Thwala, 2011). The programme tried to solve the problems mentioned above by providing employment via generating public goods and assets. Although the public sector supported the programmes they were not necessarily implemented by public sectors and communities but by private organisations. The different countries followed various implementing strategies and focused on different issues which were underpinned by the needs of the individual countries (ibid.).

There were four resources needed for supporting public works namely investment capital, wage payments, institutional capabilities and labour (McCutcheon & Taylor-Parkins, 1995; Thwala, 2011). In Africa the types of public works programmes implemented were also influenced by infrastructure and transport activities, for example, areas with easy access to food preferred cash wages and in areas where markets were not working properly owing to lack of infrastructure, 80% of the people preferred receiving food than cash. Food for work projects were successful in preventing death and mass migration of people.

In Ghana, Niger and Senegal the programmes were run on smaller scales. Mali, Morocco, Tunisia, Algeria, Maurituana and Senegal experimented with these programmes in 1960.

These projects were run through the activities of the world food programme and non-governmental organisations. In Botswana and Zimbabwe, the programmes were run by the governments themselves. In Ethiopia and Niger, the programmes were run by non-governmental organisations and international donors (ibid.).

Experiences with public work programmes in Africa vary in emphasis. In Kenya, Ethiopia Botswana and Rwanda emphasis was on infrastructure focused projects which capitalised on employment demand in order to gain control over land erosion and road development. Kenya, Zimbabwe and Nigeria focused on rural roads. Senegal focused on drainage, sewage and refuse disposal. Labour intensive methods were used in order to absorb unskilled and semi-skilled youth who cannot easily be absorbed into sectors which require specialised skills (Thwala, 2001; ibid.).

In Ghana the public works programme was involved in the creation of a network of rural towns and development of access roads. Several opportunities covering a range of skills were available to the young workers ranging from site supervisors, bricklaying, site foremen, plumbers, carpenters and tilers. Many of the youth who worked in the programmes were self-employed on completion of the programmes. Those who were not self-employed were able to find other jobs. The public works programmes were able to expose the youth to various work opportunities and skills required (ibid.).

Most of the countries above do not refer explicitly to training and skills development during the work practices or as a key objective of the programmes, although this may have been an implicit objective (ibid.). Only the Ghana case made reference to the improvement of skills. Reports on this programme show that youth emerged with a range of skills, to the extent that after the project some were self-employed while others managed to get other jobs at the end of the project. There is, however, no indication of any specific or pro-active approach to training and skills development in the process which indicates that the skills development emerged organically from the programme (ibid.).

Implementation of these programmes has not been without challenges. McCutcheon and Taylor-Parkins (1995; 2003). The challenges are inclusive of social, status related, cultural and technical problems. Thwala (2011) and Chakwizira (2010) reported that in some countries men migrated during the public work season and left the women and children behind. Some groups looked down upon manual labour, for example, the pastoralists in Niger rarely participated in

building of roads. Some programmes were neglected as they were not aligned with people's cultural preferences. Technical appraisal and supervision of projects was poor in some areas, for example in one of the projects drains were cleaned and workers did not replace the lining of the drains so when the rains came, the drains overflowed. The logistics needed in some projects made them very hard to implement. Institutional capacity for designing and implementing public works programme is said to be scarce in almost all the countries. Real coordination is frequently missing between technical ministries involved in the same project, for example a clinic is built but it takes years to obtain the drugs to make the clinic function optimally (Mahendra & Renade, 1996).

1.2.2.4 Public Works Programmes in South Africa

The Expanded Public Works Programme (EPWP) came into being as a result of a crisis of unemployment in South Africa in 2003. At that time about 8 million people were unemployed. The National Public Works Programme was established to halve unemployment by 2014 (South Africa. Parliament. 2003). The implementation of EPWP programmes in South Africa was an explicit government strategy to reduce unemployment, expand involvement in economic growth and improve qualifications and skills of the workforce so that more people are able to take up skilled work opportunities. It was a medium-term intervention with a focus on able-bodied but unskilled adults and has grown into one of the largest public works programmes in the world (Phillips, 2004).

During the 1990s engagements took place between organised labour, the construction industry and government over the use of labour intensive construction methods. This resulted in signing of a temporary agreement for labour intensive construction. These were later written into a Code of Good Practice for Special Public Works Programme and Ministerial Determination (South Africa. DoL, 2004). This programme was formally discussed with NEDLAC and gazetted by the Department of Labour in 2002 and was established as a framework for providing unemployed people with a combination of experience and training.

The first programme to be established under this National PWP framework of the RDP (ANC, 1994) was a Community Based Public Works Programme. It was intended to provide rapid visible relief for the poor and build capacities of communities for development. Funds were allocated to community-based organisations to carry out projects. This initiated the further development of a range of public works programmes after 1994, including Working for Water, Land Care and Coast Care. Provinces also initiated their own programmes, for example Gundo

Lashu Programme in Limpopo and Zibambele programme in KwaZulu-Natal (Phillips, 2004). Like elsewhere in Africa, some programmes were dominated by routine maintenance of rural access roads to provide rural households with income. Employment was allocated on a household basis so if the participating member fell sick or died, another household member could take up the employment (McCord, 2002; Phillips, 2004).

In a policy conference held in 2002, the African National Congress took a decision that there should be a large scale expansion of the use of labour intensive construction methods to alleviate unemployment. In June 2003 the Growth Development Summit resulted in a number of interventions aimed at reducing household poverty, with the Expanded Public Works Programme (EPWP) being one of them (Phillips, 2004). The EPWP was designed to provide poverty and income relief through temporary work. It was designed with a modicum of training and work experience, which should enhance the ability of the participants to earn a living in the future. It was (and still is) funded through normal budgeting; it has no separate special fund. Departments were called upon to carry out poverty relief programmes in their core functional areas and to fund these via budget line functions. The Department of Public Works was nominated to be the overall co-ordinating department of the EPWP programme.

The Expanded Public Works Programme was announced by the then President Thabo Mbeki in his State of the Nation Address in 2003. It developed into a nationwide programme covering all spheres of government and state-owned enterprises which sought to draw significant numbers of unemployed into the productive sector. Different to most other EPWP programmes (see section 1.2.2 above), it explicitly built in training, in order to support workers to gain skills while they work and increase their capacity to earn income (South Africa, 2003). It was noted in the Code of Good Practice document that "training is regarded as a critical component that strives to equip workers with skills that can be used to secure other employment opportunities and assist them to identify possible career paths available to workers exiting the programme" (South Africa. DoL, 1997, p. 1-25). As such, the South African brand of EPWP seeks to increase the capacity of the workers so that they can also earn an income in future.

This programme is divided into four sectors, namely, environment and culture, social, economic and infrastructure. Each sector consists of a number of government departments with one nominated to lead the sector. The Department of Environmental Affairs (DEA) which was then known as the Department of Environmental Affairs and Tourism (DEAT) was nominated

to lead the environment and culture sector. Within the EPWP therefore, the environment and culture sector is made up of the following departments:

- Department of Environmental Affairs,
- Department of Tourism,
- Department of Water Affairs,
- Department of Arts and Culture,
- Department of Agriculture, and
- Department of Science and Technology.

Overall, the EPWP is hosted by the Department of Public Works but each of the participating departments funds a substantial portion of the EPWP from their Medium Term Expenditure Framework (MTEF) allocation. The departments concerned report to the Department of Public Works and to Cabinet on their performance in respect of the EPWP. Labour intensive methods and skills development that supports these methods are recommended in the expanded public works programmes, as is the case in the Working on Waste programme which is the focus of this study. As indicated in section 1.1, Waste Management knowledge is a key focus in this study, and the evolution of Waste Management will be discussed as the chapter unfolds.

Adato and Haddad (2001) asserted that the public works programme in South Africa has been amongst the most innovative in the world with multiple objectives that include not only job creation but also poverty reduction, skills development, infrastructure and small medium and micro enterprise development. According to McCutcheon and Taylor-Parkins (2003, p. 200) the training components were "the quid pro quo" demanded by COSATU.

COSATU is an abbreviation for the Congress of South African Trade Unions organisation, which was launched in 1985. Before 1985 South Africa used to have a number of trade unions which were fighting against apartheid, committed to creating a non-racial, non-sexist democratic South Africa. To strengthen their front, they held talks which led to them undertaking to come together and form a Congress which was launched in 1985. Their main strategic objective is to fight for the material conditions of the working people, which is the reason why they participated in this debate. They are committed to developing workers' leadership, skills and abilities through training. In this research, the focus is on knowledge gained through workplace formal learning (training), workplace informal learning and the underlying circumstances and mechanisms informing them. Lastly, this focus is still new in

South Africa and needs to be researched to perfect its functionality and impact as well as its effects for future improvement of the programmes.

1.2.2.5 The EPWP within the Department of Environment Affairs

The Department of Environmental Affairs also responded to the call for creation of EPWP programmes by government departments. The Department of Environmental Affairs funded projects in the following focus areas, namely working on Land, Working for the Coast, Working on Waste, People and Parks, Wildlife Economy, Greening and Open Space Management, Youth Environmental Service, Working for Water and Working on Fire. The unemployed from the communities surrounding the projects are recruited for jobs in the projects. While working in the projects they undergo training. The knowledge and skills transferred and taught to the workers should be relevant to the particular EPWP project and the needs of the communities around the project (DEA, 2013). The training is implemented by accredited providers contracted by the department. The EPWP projects are utilised as an arm to promote skills development as suggested by the Environmental Sector Skills Plan at the lower levels, that is Levels 1-4 of the National Qualifications Framework (South Africa. DEA, 2010, p. 23).

Waste management is the focus of the Working on Waste (WoW) programme. The strategic objectives of this focus area are to create and support mechanisms for the protection of environmental quality, to create sustainable livelihoods through the recycling of waste, to support the use of environmentally friendly waste disposal technologies and to promote waste management education and awareness in the communities. The programme is guided by leading South African waste management legislative frameworks in the sector which are inclusive of the Constitution of the Republic of South Africa (South Africa,. Constitution, 1996), the Waste Management Act of 2008 (South Africa. [DEA], 2008) and the Waste Management Strategy of 2011 (South Africa. DEA, 2011). The DEA, as a custodian for environmental management, is mandated to ensure safe and healthy environments that are not harmful to the well-being of the citizens of the country (South Africa. DEA, 2013). Working on Waste is therefore one of the initiatives of DEA which seeks to ensure that both social and ecological sustainability are achieved through implementation of sustainable waste management practices.

The projects under this focus area are divided into categories. These categories entail both infrastructure and non-infrastructure projects. Infrastructure projects include construction of facilities which include development of landfill sites, construction of buyback centres, construction of recovery facilities and composting facilities. The less intensive infrastructure projects include street cleaning and beautification projects, domestic waste collection projects and cleanest municipalities competitions. As these projects are situated in the municipalities of the rural towns, most of the waste dealt with in this area is solid waste. It is generally regarded that solid waste management is the sole duty and responsibility of local authorities and even in terms of the Constitution (Act 108 of 1996) (South Africa, 1996). Municipalities are responsible for refuse removal, refuse dumps and solid waste disposal (Part B, Schedule 5). This is the group of projects which is utilised as the focus of this research.

As indicated previously, DEA is not a training institution; it does not package its own training programmes. It utilises the qualifications which form the core of the qualifications packaged, recommended and listed in website of the Local Government Sector Education and Training Authority (LGSETA). Within the LGSETA, the organisations package their own skills programmes. Skills programmes are learning programmes that are based on a collection of unit standards that will enable a learner to develop specific skills. It should be noted here that such skills programmes also have 'embedded knowledge' i.e. they *do* have knowledge structures, and potentially also knower structures embedded in them, even though this may not always be fully explicit. Completing a series of skills programmes over a period of time could lead to a national qualification if all of the skills programmes are designed to articulate within a full qualification (South Africa. DoL, 1998, p. 15). These skills programmes are used as a key modality for implementing the National Skills Act of 1998 (South Africa, 1998).

The EPWP projects in DEA vary in duration from one year to three years. The short-term nature of some of the EPWP projects makes it impossible for the workers to be trained via extended training interventions such as year-long learnerships. For this reason, skills programmes (rather than learnerships) become the most widely used form of formal skills development intervention in the EPWP because of the shorter duration of the projects and worker contracts. Most of the learners on the DEA EPWP programmes receive training at NQF Level 2, which is where this research will be focused. DEA contracts accredited service providers to do the training. This type of training forms the formal part of training implemented in the projects.

My responsibilities in the programme involve reviewing and quality managing these training programmes for DEA. Besides the more technical aspects of quality management, I developed an interest in understanding more about the quality of learning that takes place during the training offered by service providers and completed a master's degree on that topic in 2011 (Giqwa, 2011). Moreover, it is envisaged through the policies of EPWP that participating in the activities and the training activities of the projects will improve the present and the future status of the worker and the environment in which it is implemented. Sometimes at the end of the project, however, the state of affairs returns to how it was found to be before the project commenced, rendering the training ineffective. As a manager of the processes, I asked myself questions about where the challenges lie from an education and training point of view. Do they lie with the waste management knowledge structure, on how that knowledge is recontextualised in both skills programmes and providers' materials, or do the challenges lie in how such knowledge is reproduced and circulated?

Therefore, in this study, I focused on understanding knowledge structuring and recontextualisation in the environmental EPWP waste management projects' training courses, course materials and workplaces, and also on how the workplace acts or structures the development of knowledge amongst the workers, as well as how knowledge circulates amongst workers in both formal and informal training activities.

To do this, I needed to develop a deeper insight into waste management knowledge developed by knowledge producers in the sub-field, and how this knowledge is recontextualised into qualifications and training documents used in workplaces. I also needed to develop an understanding of how that knowledge circulates amongst learners in training sessions and in workplaces (there is a strong link here because the training is supposed to be work integrated, see below) (see section 1.3.2 below where the research questions are outlined). In this study, my focus is on EPWP ***waste management*** knowledge, training programmes and activities only. I therefore review the evolution of Waste Management next. This serves as a contextual introduction to the more detailed analysis of waste management knowledge which I undertake in Chapter 4 of this study.

1.2.3 The Evolution of Waste Management

Kumar and Pandit (2013, p. 1) explained that waste management is the entire process of dealing with waste from collection to disposing it hygienically so that it does not create harmful effects

to society and communities. Agenda 21, the main recommendation document emerging from the UN Conference of 1992, defined solid wastes as including all domestic refuse and non-hazardous wastes such as commercial and institutional waste, street sweepings and construction debris. Agenda 21 suggested that sound waste management must go beyond the mere safe disposal or recovery of wastes that are generated and focus on the root cause of the problem by attempting to change unsustainable patterns of its production and consumption (ibid.). It suggested that waste management should be based on four major waste-related programmes as a focus namely:

- Minimising waste;
- Maximising environmentally sound waste reuse and recycling;
- Promoting environmentally sound waste disposal and treatment; and
- Extending waste service coverage (ibid.).

Ten years later, in 2002, the next major international environmental summit on sustainable development was held in South Africa in Johannesburg. The Johannesburg Summit renewed the commitment as advanced in Agenda 21. The Summit recommended the prevention and minimisation of waste and the maximisation of reuse, recycling, and use of environmentally friendly alternative materials, in order to minimise adverse effects on the environment and improve resource efficiency (UN, 2002). It further recommended full participation of government authorities and all stakeholders, with financial assistance for developing countries (ibid.). Small-scale recycling initiatives that support urban and rural waste management and income generating opportunities were recommended as a key strategy to take the global waste management process forward. Lastly, it suggested that intergovernmental organisations and governments throughout the world should ensure sufficient national, regional and international capacities to monitor waste trends, implement waste minimisation policies and reduce production of waste destined for final disposal in landfills (ibid.).

This theme of global waste management was taken forward at the subsequent Rio +20 Earth Summit held in 2012, and in its major outcome document entitled *The Future We Want* (UN, 2012). In addition to extending the commitment to chemical and hazardous waste management, the document recommends a life cycle approach to waste management, and re-commits to key processes of reducing, reusing and recycling waste (the 3Rs) and suggests a need to give more attention to increasing energy recovery from waste. It furthermore re-emphasises the importance of sustainable consumption and production as means of addressing the root causes

of waste production. It once again affirms the need for support for developing countries for implementing sound waste management approaches, policies and institutional arrangements. It also, in the spirit of extending the Green Economy, calls for "continued, new and innovative public-private partnerships among industry, governments, academia and other non-governmental stakeholders, aiming to enhance capacity and technology for environmentally sound chemical and waste management, including for waste prevention" (ibid., p. 57).

Most recently, the Sustainable Development Goals were proclaimed by the UN (2015) to replace the earlier Millennium Development Goals. Waste management, in this document, is covered under Goal 12: Responsible Consumption and Production, and here the significance of reducing food waste is highlighted, as well as strategies to reduce waste production, such as sustainable procurement, prevention, development of scientific and technological capabilities to reduce waste production and implementing other measures to rationalise inefficient fossil fuel policies that encourage wasteful consumption and market distortions (www.globalgoals.org).

From the above brief scoping of the international policy discourse on waste management, it is interesting to note the evolution of waste management discourse from a focus on reduction and recycling, to a focus on prevention, with ever-more sophisticated strategies being promoted such as life-cycle approaches to waste management, and sustainable procurement and transformation of market distortions. Across this landscape of evolutionary thinking is a realisation that extra resources and support are needed for developing countries to achieve the implementation of these approaches, and wider acknowledgement of the need for smaller scale and innovative approaches to waste management that are also labour intensive are recognised as a strategic approach for developing countries. This does not preclude emphasis on improved technologies and addressing the waste management problem at source, namely in the production and consumption system.

1.2.3.1 Waste Management in Africa

Simelane and Mohee (2012) asserted that the attractiveness of many cities in Africa is marred by the inefficient collection, management and reuse of municipal solid waste. They noted too that there is a political and historical background to issues of waste management in Africa. On the one hand, there are allegations that some African countries are dumping grounds for

hazardous waste produced in other developed countries. For example, Malakata (2015) reported that:

> European Commission and UN studies show that West Africa is becoming a dumping site for e-waste from various parts of the world. Meanwhile, communication technology and services firm Ericsson says West Africa is becoming highly affected by e-waste, relative to other regions on the continent. The problem is compounded by the fact that most countries in Africa do not have e-waste recycling facilities. The lack of facilities results in careless disposal of electronic products.

On the other hand, waste management issues in Africa are related to the rapid growth of population and urbanisation in African cities like Nairobi, Dar es Salaam, Lagos and Cairo experiencing high population growth trends because of migration. This rapid change and concentration of people, coupled with unsustainable production systems, results in increased production of solid waste. Because of this influx, and the need for substantive infrastructure for waste management which often cannot keep up with the pressures of urbanisation, solid waste systems become inefficient to the extent that these cities lose their attractiveness. Compounding this is a lack of proper landfill sites in most African countries and waste is often dumped in any open space. This creates environmental health risks, and many of the cities are perceived as unhealthy because of this. Oteng-Ababio, Arguello and Gabbay (2013) writing from Ghana, stated that "municipal solid waste management continues to be an environmental health burden in many African cities". They claimed that city authorities are often "overwhelmed with the magnitude of the problem" and tend then to seek out costly technological solutions from the 'north', which often do not work well in local conditions due to a range of infrastructural, skills and funding factors. Using case studies from Accra, they highlighted the importance of recognising the innovations of 'informal' waste pickers and legitimising them within the formal system.

Simelane and Mohee (2012) also identified that there are disparities in the waste volumes generated according to income. They indicated that higher income areas generate more waste volume than lower income areas. Of this, 95% is neither contained nor recycled. It is thrown away at dumping sites on the periphery of the urban centres or at temporary sites. These inefficient forms of solid waste disposal have serious health impacts. They pollute the environment, pollute nearby rivers and act as breeding grounds for diseases. They suggested that "the inability of African countries to make efficient use of their waste through re-use suggests that as a future direction, African countries need to adopt a set of appropriate technologies that will assist them to convert waste into re-usable assets" (p. 1), noting this as

an under-developed area of innovation in Africa since by 2020, more than 50% of the population in sub-Saharan Africa will be living in cities (Ahmed & Ali, 2004).

Closer to South Africa, the Southern African Development Community (SADC) has also identified waste management as a priority issue. It states that:

> Waste Management is one of the priority issues affecting the SADC Region. The rising quality of life and high rates of resource consumption patterns have had an unintended and negative impact on the urban environment. They have resulted in generation of waste beyond the handling capacities of the majority of waste management authorities. The majority of SADC cities are now grappling with the problems of high volumes of waste, low capacity to management and the high costs involved in the management. This is further exacerbated by the lack of proper disposal technologies and methodologies, inadequate manpower and equipment. This, coupled with poor enforcement, results in rampant illegal dumping of domestic and industrial waste that is a common practice. This has had serious health and environmental impacts resulting from littering, generation of foul smell and proliferation of pests and insects that transmit diseases. (SADC, 2017)

Throughout Africa, currently less than half of the solid waste that is generated is collected, recycled, reused or processed within life cycle waste management systems (ibid.). Waste management knowledge would therefore seem to be significant for Africa's development, and if, as suggested by Oteng-Ababio et al. (2013), waste management should focus on legitimising the knowledge and practices of local 'waste pickers' within the waste management system, there is need to consider waste management knowledge not only from a technological solutions point of view as proposed by Simelane and Mohee (2012), but also from a local social knowledge and practice point of view as proposed by Oteng-Ababio et al. (2013).

1.2.3.2 The Evolution of Waste Management Policy in South Africa

1.2.3.2.1 Prior to 1994

In South Africa a formal waste collection service was first implemented in the Cape Colony in 1786. In 1820 a regular waste collection service was already available on specific days of the week and animal drawn vehicles were used for collection. In 1920 motor vehicles were used for the first time for waste collection (South Africa. DEA, 2010b).

After that waste management in South Africa was managed by various pieces of legislation which were scattered among departments. The pieces of legislation included the following:

- Water Act of 1956;
- Atmospheric Pollution Prevention Act of 1965;

- Health Act of 1977;
- Environmental Conservation Act 73 of 1989 (South Africa. Department of Human Settlements [DHS], undated).

The Water Act of 1956 (sections 21, 22, 23 and 26) cover the prevention of pollution by effluent, storm water control, location of waste sites, offences and penalties, policies and strategies. Its controlling authority was the Department of Water Affairs and Forestry.

The Atmospheric Pollution Prevention Act of 1965 (sections 1, 17, 18, 19, 20, 27, 28 and 33) covered definitions, prevention of burning, smoke control, smoke and dust control areas and regulations. This legislation was under the authority of the Department of National Health and Population in conjunction with Local Authorities.

The Health Act of 1977 included waste issues in sections 1, 20, 38, 39, 40 and 57. These sections cover definitions, prevention of pollution of water for human consumption, regulations regarding communicable diseases and relating to rubbish, night soil nuisances, offences and penalties. It was developed and managed by the Department of the National Health and Population Development.

The Environmental Conservation Act 73 of 1989 addressed structural issues, littering and management of waste. It defined 'waste' as any matter whether gaseous, liquid or solid or any combination thereof, which is from time to time designated by Minister by notice in the gazette as an undesirable or superfluous emission, residue or remainder of any process or activity. It defined 'litter' as any object or matter discarded or left behind by the person in whose possession or control it was (South Africa. DEAT, 1989)

This Act was concerned with a war against littering and dumping of litter on land, water surfaces, roads and sites. It recommended that there should be places and containers which are set aside for the sake of dumping. It called upon authorities in control to ensure that adequate and suitable containers and places are provided for discarding of litter by the public (South Africa. DEAT, 1989). It appealed to authorities to make sure that all litter dumped and discarded wherever, for example on land, street, and roads, is removed.

This Act (1989) focussed mainly on how litter and waste were to be managed, for example Clause 20 of the Act regulated how disposal sites need to be managed. It indicated that no person could operate a disposal site without a permit issued by the Minister of the Department

of Water Affairs. The Minister was also responsible for the maintenance of the register in which disposal sites were recorded; for giving directions on controlling the management of the different types of waste disposal sites; and for the publishing and issuing of regulations and procedures to be followed on the withdrawal of disposal sites. Clause 24 provides further detail on the responsibilities of the Minister, which included overseeing:

- The manner in which applications for permits are submitted;
- Statistics on the quantity and types of waste produced;
- Classification of the different types of waste, their handling, storage, transport and disposal of waste;
- Reduction of waste;
- Utilisation of waste by way of recovery, reuse or processing of waste;
- Location, planning and design of disposal sites, installations and equipment used for the effective disposal of waste;
- Management of sites used for waste disposal;
- Making regulations regarding the dumping of litter;
- Making regulations on the nature, the design, number, provision and placing of containers for the dumping of litter; and
- Making regulations on the power of provinces, local authorities and governance institutions to control and prevent dumping (South Africa. DEA, 1989, pp. 24, 24A).

This legislation established a certain discourse and knowledge system for waste management in South Africa, focussing mainly on end-of-pipe processes of waste processing and management after the waste had been produced. As can be seen the major intention was to reduce dumping of waste and litter via disposal in dedicated and management disposal sites. Efforts and training were focussed on effective landfill construction and management, classification of types of waste, storage, disposal. Even at this time, however, there was talk of waste reduction and re-use, although this was not the dominant discourse.

1.2.3.2.2 Evolution of Waste Management in South Africa after 1994

1994 signalled a significant change in the social and political landscape in South Africa, as the first democratically elected government came into power. The new government began to address the impacts of the earlier draconian and separatist policy Acts, namely the Natives Land Act of 1913, the Native Trust Land Act of 1936, the Group Areas Act 41 of 1950 and the

Group Areas Act 36 of 1966. These Acts were designed to segregate the Black population, manage urbanisation and limit the movement of Black Africans. Black people were not allowed to stay in urban areas for more than 72 hours. The urban areas were deemed for Whites only. The draconian acts curtailed people's movements and forced many people to live in former 'homeland' areas. These acts were abolished by FW De Klerk after the disbandment of the ANC. The Abolition of Racially Based Land Measures Act 108 of 1991 was introduced. It enabled all South Africans, regardless of race, to occupy and own land in any part of the country without any fear of prosecution (Klopper & Pienaar, 2014, p. 688). People in South Africa were free to move and live where they chose. This naturally led to rapid movements from rural areas to cities, which has had implications for the emergence of waste management discourse and waste policies in South Africa, as will be outlined below.

Mpako-Ntusi (2002) has described a scenario of rural citizens in South Africa which encouraged people to move from the rural to the urban areas. She claimed that the families in the rural areas of South Africa used to work collectively to meet their survival needs. They practised subsistence farming. Natural resources, human intellect and physical energy were adequate and life was good. However, lives of Black people in South Africa were disrupted by the various forms of colonial and apartheid separatist development which drew labour from the rural areas, but which did not allow people to move freely. This was further clarified by Turok (2012) who describes the complex urbanisation patterns of South Africa. Turok (2012) described these as being 'distorted' due to the historical trajectory of South Africa:

> In the late 19th and early 20th centuries, a distinctive form of racially segregated urban development was put in place, reflecting the needs of the economy for cheap migrant labour to support rapid industrialization, but political nervousness about permanent rural-to-urban migration. After the Second World War, political considerations dominated and increasingly draconian controls were imposed to suppress black urbanization in order to sustain white lifestyles and political domination. Their main effect was to fracture the physical form of cities and disrupt the lives of black residents through forcing them to the periphery. With the demise of apartheid, these repressive controls have been withdrawn, causing a recovery in the rate of urbanization … [However] … there is no consistent national policy for planning and managing the present and significant process of urbanization. … The post-1994 government recognizes the problems of a distorted urban form, but its policies have been too short term and sector-specific to bring about significant settlement restructuring. Indeed, some of the pro-poor policies have reinforced people's exclusion by subsidizing the cost of living on the periphery, rather than supporting better location decisions. (p. 1)

Thus, in an attempt to change their social conditions and improve their lives, people moved from subsistence farming and home manufacturing of goods to economic and industrial

farming and migrant labour. People moved to the urban centres. This resulted in population growth, economic development for some and increased urbanisation. These three factors mentioned by Mpako-Ntusi (2002) have been identified as drivers of increased municipal waste generation in South Africa, especially as unplanned and 'distorted' urban development took place as described by Turok (2012). This developed hand in hand with inappropriate waste disposal practices. The increase in waste generation and inappropriate waste management and disposal practices resulted in ecological degradation and pollution of the receiving environment, spread of diseases and increased risk to human health. A need was therefore identified to adapt waste management practice to minimise waste generation and limit the impact waste has on human health and the natural environment.

The new Constitution of South Africa (Act 108 of 1996), which is the supreme law of the country, was established and published in 1996. In response to the historical inequalities, the South African Constitution sought to create a human rights foundation for society and government. In section 24 of Chapter 2 it affirms the right of all citizens to an environment that is not harmful to their health and well-being. The Constitution states that the environment should be protected for the benefit of present and future generations through reasonable legislation and the measures that seek to prevent pollution and ecological degradation. In Chapter 3 section 40(1) and 41(5b) the Constitution enlists matters that fall within the jurisdiction of the municipalities. These include refuse removal, refuse dumps and solid waste disposal.

In 1995 after the first elections inclusive of the disadvantaged groups in South Africa, a Consultative National Environmental Policy process (CONNEPP) was established. It produced a White Paper on Environmental Management in 1997. The main goal of this paper was to review existing legislation and identify key new legislative priorities for the democratic dispensation. The policy goal resulted in the development of the National Environmental Management Act 107 of 1998 (NEMA) (South Africa. DHS, undated).

In relation to waste management, NEMA (South Africa, 1998) established the principle of waste avoidance as the most basic objective of waste management, changing the earlier end-of-pipe discourse significantly. The Act emphasised that "pollution, waste and degradation of the environment should be avoided and where it cannot, its toxicity should be minimised, and amounts of waste generated be reused or recycled where possible and otherwise be disposed of in a responsible and environmentally sound manner that takes into account the consequences

of the depletion of resources" (South Africa. Department of Environmental Affairs and Tourism [DEAT], 1998, p. 32). Planning was identified as a requirement to prevent, minimise and remedy negative impacts on the environment and human health. Utilisation of a life cycle approach to waste management which encompassed extended producer responsibility was proposed, taking forward the waste avoidance discourse. The establishment of the 'polluter pays principle' (i.e. impact costs should be paid for by those responsible for harming the environment) was included in the Act. NEMA (South Africa. DEA, 1997) which is the over-arching Act governing environmental management in South Africa, prepared the way for development of a White Paper on Integrated Pollution and Waste Management for South Africa, which was published in March 2000 (South Africa. DEA, 2000).

When the White Paper on Integrated Pollution and Waste Management was developed, the importance of an integrated approach to waste management surfaced, again changing the national waste management discourse. This implied the coordination of functions within the waste hierarchy. The White Paper specified the need for a review of legislation pertaining to waste management. It consolidated the shift of focus from waste disposal, i.e. end-of-pipe treatment discourse, to waste prevention discourse which is inclusive of waste avoidance, minimisation, reuse and recycling, a discourse which was already identified and established internationally. Additionally, it identified the roles of different spheres of government in relation to waste. The role of the National Department of Environmental Affairs was identified as providing leadership and guidance to provincial environmental departments and municipalities through development of policy, strategies and legislation. This was further clarified to include coordination, enforcement, dissemination of information, monitoring, auditing and capacity building. Provincial government was tasked with the responsibility for implementing strategies, and monitoring and enforcement of pollution regulations within their provinces. Municipalities (i.e. local government) were responsible for refuse removal, management of refuse dumps and solid waste disposal. They were also tasked to develop integrated waste management plans which were seen to be sector plans of their integrated development plans. One of the problems associated with this was the fact that legislation to oversee enforcement of these waste management plans did not exist, and as a result, waste was not always seen as a priority by municipalities as it competes with resources for basic needs such as food security, employment, water, sanitation, education and security (Godfrey, 2008; South Africa. DEA, 2000). The White Paper therefore recommended the review of all waste related legislation and the establishment of a single piece of legislation which deals with all

waste and pollution matters. The recommendation led to the development of the National Environmental Management: Waste Act (NEMWA), Act No. 59 of 2008 (South Africa. DEA, 2008).

The purpose of the Act was to reform the laws regulating waste management, protect the health of people and the environment by prevention of pollution and ecological degradation. It also seeks to provide for securing ecologically sustainable development, and to provide for institutional arrangements and planning matters. The Act carries forward the waste avoidance and integrated approach to Waste Management put forward in the White Paper, thus aligning South African waste management discourse and legislation with international trends as noted in section 1.2.3.2 above. This background to the evolution of waste management discourse and policy outlined above is both informed by the generation of waste management knowledge (see Chapter 4) and is significant for shaping waste management training (see Chapter 5). It therefore provides the backdrop to the focus on waste management knowledge in workplace learning and training which is foregrounded for study in this thesis as noted in section 1.1 of this chapter. The next paragraph therefore discusses why the study focuses on waste management and knowledge which lead to the research problem and research questions.

1.2.3.3 Why the study focuses on waste management?

Policy and practice rationale: Waste management is one of the critical areas managed by DEA and its backdrop is discussed at length in section 1.2.3.2 as traced from the South African Constitution. Waste practices in South Africa are mostly not conducive to a healthy environment and impact heavily on the poor with various adverse effects. Skills development, capacity building and training to implement the transition to an 'avoidance' approach to waste management, as outlined in South Africa's new waste management legislation, has been identified in the Environmental Sector Strategic Plan (2005-2013) as a priority for skills development (South Africa. DEA, 2010, p. 21). Worker training at Levels 2-4 in waste management was noted as a priority in the Environmental Sector Skills Plan (South Africa. DEA, 2010) as such training has previously been neglected (see above), and not much is known about training, learning and knowledge circulation at this level (ibid.).

Efficacy rationale: Waste projects are established by the department in municipalities to curb this environmental hazard. Training focussing on waste management is conducted in waste projects funded by EPWP, but, as noted above, sometimes at the end of the project the state of

affairs returns to how it was found to be before the project commenced. This provides the impetus for this study, as noted above, and my curiosity related to the nature of the knowledge, the knowledge transferred and how it circulates amongst the workers in order to contribute towards the actual development of secure healthy, ecological, sustainable environments.

Training programme construction rationale: Within the implementation of the South African National Qualifications Framework, unit standards-based training has been critiqued for absenting knowledge in favour of outcomes. Allais (2006) commented that in the NQF, knowledge is relegated to a category called 'essential embedded knowledge' "meaning that it is not taken as the starting point or as being at the centre but as underpinning outcomes and competences" (Allais, 2006. pp. 23-26).

As noted in section 1.1 above, Muller, as cited by Peden (2008), commented that knowledge lies at the heart of the debates in South African Education, Training and Development today. Researchers working with a social realist approach such as Maton (2008), Moore and Muller (1999), and Wheelahan (2010) have argued that knowledge has been taken for granted and ignored in research in the sociology of education (see further discussion on this in Chapter 2). They claimed that emphasis has tended to be on studies on how knowledge works to reproduce external social relations of power rather than on knowledge itself. They complain that "knowledge has been reduced to power" (Maton & Moore 2010, p. 26). However, most of the sociology of knowledge research undertaken by social realist researchers has been in higher education and formal schooling curricula, with emphasis on curriculum, pedagogy and disciplines. In this study, the focus is different; it is on workplace learning in EPWP, where participants are at NQF Level 2 which is the second level of the waste learning pathways in this qualification. Training at this level has elements of both formal and informal training activities. The participants have low levels of formal education while others have been out of school for a long time.

Figure 1 that follows shows the South African NQF and positions the focus of the training that I will be investigating at Level 2, in the occupationally directed stream of training.

NQF level	Sub-framework and qualification types		
10	*Higher Education Qualifications Sub-framework (HEQSF): The Council on Higher Education (CHE)*	Doctoral degree Doctoral Degree (Professional)	*Occupational Qualifications Sub-framework (OQSF): The Quality Council for Trades and Occupations (QCTO)*
9		Masters Degree Masters Degree (Professional)	*
8		Bachelor Honours Degree Postgraduate Diploma Bachelors Degree	*
7		Bachelors Degree Advanced Diploma	*
6		Diploma Advanced Certificate	Occupational Certificate (Level 6)
5		Higher Certificate	Occupational Certificate (Level 5)
4	*General and Further Education and Training Sub-framework (GFETSF): Umalusi*	National Certificate Secondary school grade 12	Occupational Certificate (Level 4)
3		Intermediate Certificate Secondary school grade 11	Occupational Certificate (Level 3)
2		Elementary Certificate Secondary school grade 10	Occupational Certificate (Level 2)
1		General Certificate *ABET Level 4 Primary school Grade 7 and Secondary school grade 8-9	Occupational Certificate (Level 1)

*Qualification types beyond Level 6 on the OQSF have not been determined pending further advice
*ABET: Adult Basic Education and Training

Figure 1.1: The South African National Qualifications Framework showing levels of qualification (Source: Adapted from SAQA, in Togo, Zhou & Kahn, 2013)

1.2.3.5 Workplace learning and EPWP training

The workplace-training mandate of the EPWP has diverse interpretations among the stakeholders in South Africa. Some interpret it as on the job training only where workers learn skills from each other, while others interpret it as an opportunity for gaining knowledge and skills which can enable them to join the education stream or ladder as indicated in the Skills Development Act (South Africa, 1998). Allais (2006), for example, commented that there is no proper attention given to knowledge, learning materials, training educators and improvement of facilities in workplace training in South Africa. She complained about an absence of well-designed programmes, well-prepared teachers and a problem of non-transferability of knowledge. Jonsdottir (2006) and Tinnabutr (2009) however, concurred that both formal and informal workplace learning can be transformed into increased productivity and can be of value if carefully planned and well implemented. Both formal and informal workplace learning are a focus of this study.

1.3 RESEARCH PROBLEM AND QUESTIONS

1.3.1 Research Problem

As noted above, little is known about knowledge and its circulation in EPWP training programmes, yet knowledge is said to be at the heart of education and training in South Africa. As noted above too, there appears to be a disjuncture between the training being offered in the EPWP programmes and the practices of workers after being part of the programmes. Unit standard based training has been critiqued as lacking an adequate focus on knowledge. All of this raised the problem of how knowledge circulates amongst workers in both formal and informal training activities, and how this influences the development of participants' expertise, which could ultimately promote the sustainability of the waste management activities of the Working on Waste projects when the programmes end.

1.3.2 Study Aim and Research Questions

The aim of the study is to investigate the structure of legitimate knowledge developed by producers in the waste management field, its recontextualisation in training programmes, manuals and documents and how it circulates and is reproduced in the EPWP waste management pedagogic practices inclusive of workplaces (informal) and associated training activities (formal).[1]

Research questions: The main research question investigates legitimate knowledge in waste management, its recontextualisation and how it circulates through formal and informal waste management activities in the EPWP projects. It is scrutinised by exploring answers to the following sub-questions:

1. What is the structure of legitimate knowledge and knowers in waste management?
2. What are the underlying principles underpinning knowledge and knowers in waste management?
3. How is the knowledge recontextualised in waste management training qualifications, documents and manuals for worker training at NQF Level 2?
4. How is the knowledge reproduced and evaluated in the waste management EPWP training activities (formal) and workplaces (informal)?

[1] I include 'associated training activities' here as these form a part of the EPWP skills development programmes as mentioned earlier.

5. How does waste management knowledge circulate amongst the workers in the EPWP training activities and workplaces?

The first sub-question focuses on investigating the structure, nature and development of what is considered legitimate knowledge and knowers within the field of waste management at the level of knowledge production. The second sub-question explores the underlying principles underpinning that knowledge and knower structure at the level of knowledge production using Maton's (2013) Legitimate Code Theory (LCT, see Chapter 2). The third sub-question investigates how the waste management knowledge is recontextualised (see Bernstein's pedagogic device in Chapter 2), framed and sequenced in qualifications, skills programmes and training providers' materials at Level 2 of the NQF. Sub-questions 4 and 5 investigate the reproduction and circulation of knowledge in both formal and informal learning settings within the project. The formal settings are inclusive of training activities planned and implemented in the project while the informal settings include the whole process of participation in the project activities. The circulation analysis is also inclusive of the dispositions or the previous experiences of the workers, that is how their waste management activities in the project are influenced by their prior knowledge and experiences before they joined the EPWP programme. Their waste management practices are traced from home and previous schools' experiences into their current workplace engagements.

This research is guided by social realist theory as evidenced in Bernstein's (1990) theory of knowledge structures and Maton's (2013) Legitimate Code Theory (LCT), which builds on Bernstein's earlier work. They both allow for analysis of the knowledge structures and the knower as well as circulation of knowledge (see Chapter 2 for a more detailed discussion on these theoretical perspectives as used to guide this study). According to Maton and Moore (2010), a social realist interpretation of knowledge emanates from, and is based on, a critical realist philosophical view of ontological realism, which believes in the view that "knowledge is about something other than itself and there exists a reality beyond the symbols we see" (Maton & Moore, 2010, p. 4). Social realists argue that all knowledge is both social and real. It is social because it is socially produced by the communities of knowledge producers and real because it is about an objective world that exists independently of our social constructions of it (Wheelahan, 2010, pp. 7-8). They argue that while all jobs require contextual-specific knowledge, they also require theoretical ideas shared by the community of specialists located in that field (Young, 2006, p. 115). Learners therefore need to have epistemic access to decontextualised knowledge. As indicated above, the focus of this study is to determine which

knowledge is emphasised in environmental waste management EPWP projects. This entails an analysis of knowledge and knower structures and how these shape learning in the EPWP projects.

1.4 OUTLINE OF THE CHAPTERS

Chapter 1: This chapter commences with the discussion of broader historical and contextual background of the study as well as the origins and the establishment of the Expanded Public Works Programme (EPWP) abroad and in South Africa. The EPWP and its emphasis on skills development and creation of employment form the core contextual setting for this study, as does the focus on waste management, which is one of the key focus areas of the Department of Environmental Affair's EPWP interventions. The chapter introduces the origins of waste management challenges in South Africa as waste management and knowledge building in both formal and informal projects activities are the foci of the study. The research questions and a brief overview of the study are also provided.

Chapter 2: This chapter presents the conceptual and theoretical dimensions of the study as relevant to the problem being investigated. The literature review is structured into two main sections. The first section discusses the issues relating to learning and workplace learning. The aim is to familiarise the readers with the background and approaches to learning and workplace learning. The second section discusses the social realist theoretical framework which guided the study, introducing Bernstein's (1990) theory of recontextualisation within the pedagogic device and Maton's (2013) Legitimate Code Theory and the aspects of these theoretical frameworks that were used in the study.

Chapter 3: This chapter presents the methodology, research design, methods and modes of analysis employed in the research. The research design and the outline of the methods used for data generation are sketched out. The processes of conceptual development and application characterising the data analysis are explained, as are processes used to ensure trustworthiness and ethical practice in the research.

Chapter 4: This chapter is the first of five chapters that report on the findings of the study. It addresses the first two sub-questions of this research which investigate the structure of legitimate knowledge developed by knowledge producers in the waste management sub-field (a sub-field of the Environmental Sciences) in the level of production. The field of production

is where new knowledge is constructed (Bernstein, 1990, p. 206; Maton, 2013, p. 47). This investigation used research papers produced by specialists in the field of waste management. The first finding which surfaced from the waste content knowledge analysis signifies that waste is a region and is both interdisciplinary and multidisciplinary. The knowledge aspects of waste management knowledge develop and change within time and space. Waste management knowledge is applied in a number of occupations, professions and companies namely environmental health, people's health, engineering, economic aspects, natural resources, industries, municipalities, and social justice. The chapter reveals that the knowledge code/ epistemic relation to the object legitimates a strong specialist knowledge offering a strong *epistemic relation* (ER+) while the social *relation* is weaker (SR-). Overall, as discussed in this chapter, the underlying principles depicted show that waste management knowledge producers emphasise the epistemic relation to the object more than the social and the personal experiences of actors at the level of production.

Chapter 5: This chapter is the second of the four chapters that report on the findings of the study. This chapter focuses on the recontextualisation of waste management knowledge from the level of production into waste management qualifications, programmes and documents at Level 2 of the National Qualification framework. As shown in this chapter, at this level the framing of knowledge in the qualification and skills programmes is strong. The chapter shares insight into how the leaders in government dealing with environmental policies and legal frameworks and the leading organisations in waste management developed the qualifications and the skills programmes and put forward or relocated issues which are of concern to government in government legal frameworks. The chapter also reveals that providers of training and the workers to be trained did not participate much in the development of qualifications and skills programmes. Recontextualisation during development of learning materials of two providers were analysed and are described in this chapter. The chapter reveals that some providers leave out some of the topics suggested in the qualifications and substitute them with others, and that they apply the content in different contexts, for example, one applied the content in an urban setting while the other kept it generic. The chapter shows that during recontextualisation, knowledge prescribed by the lead departments and knowledge in legal frameworks is emphasised; this shows that framing and the epistemic relation (ER+), even during the development of learning materials, is strong.

Chapter 6: This chapter is the third of the four chapters that report on the findings of the study. The chapter focusses on the waste management knowledge and the experiences the workers bring to the project. It considers whether there is a clash or match between knowledge and experience gained at home, school and in the projects which influence the circulation of knowledge. The circulation of knowledge is investigated through the dispositions and the experiences the workers bring to the project; practices and actions in the early period of workers' participation in the EPWP projects are also analysed. The chapter reveals that waste management activities from home and previous schools' experience emphasise everyday knowledge more than specialist, scientific waste management knowledge. The social relations to the subject are emphasised more (SR+) than the epistemic relation (ER-) to the object. The chapter also reveals that during the early weeks of the project, both epistemic and social relations form the basis of achievement at this level. The activities of the project seek to expose the workers to specialist knowledge of waste management (types of waste and the waste hierarchy) but specialist legal frameworks (waste regulations and legal obligations of municipalities) are not put into practice in the activities of the town. Thus social aspects, and home practices of the workers are still dominant (SR+). It is clear therefore that there is a code clash between the waste management knowledge brought by the workers from their previous life experiences and the waste and waste management specialist knowledge being put forward by the projects (SR+ vs ER+).

Chapter 7: This chapter is the fourth of the chapters that report on the findings of the study. It focusses on the reproduction and circulation of knowledge in the waste management formal and informal pedagogic interactions. The chapter therefore shares insight into the reproduction and circulation of knowledge in waste management training and learning settings. Observations of formal training activities and interviews of workers in one of the workplaces was conducted. The training activities signify the formal part investigated while interviews in workplaces represent the informal part of learning researched. Findings reported in this chapter reveal that though the provider was committed to utilise interactive approaches or invisible pedagogies, there was a shortage / lack of cooperation from the side of the learners. The chapter also shows how the specialisation dimension of LCT was used to determine the basis of achievement within the interactions. The specialisation dimension pointed to a strong epistemic relation (ER+) and a weaker social relation (SR-). The chapter also reports on how the semantic dimension of LCT and its origins were traced and how the semantic dimension was used to determine how knowledge is built in the interactions. The prominence of downward escalators

demonstrates that abstract, specialised, academic knowledge at a high level of semantic density (SD+) is emphasised and is therefore unpacked using everyday language and examples to reach the lower flat line/ high level of gravity (SG-), meaning that there are many decontextualised concepts, processes and procedures which facilitators try to contextualise throughout the interactions between the facilitator and the learners using this strategy (SD+/SG- to SD-/SG+). The chapter also shares insight into the circulation of knowledge in workplaces. It displays the different ways in which the workers learn. It further shows the emergence of waste management knowledge as the workers participated and interacted with stakeholders in the project. The findings shared in the chapter show that workers utilised waste management practises that were relevant to their social practises at home and school during the first months of the project. They were not exposed or clear about the scientific knowledge/ specialised knowledge processes and procedures in waste management which were not relevant to their social practices in the rural areas, for example they knew what to do with the plants while they struggled with what to do with paper and plastic. Through their interaction with other stakeholders in the project and through formal training, their scholarly scientific waste management knowledge was strengthened.

Chapter 8: This is the final chapter of the study. It discusses the key findings of the study in light of the theoretical perspectives suggested in Chapter 2 and as used in the analysis. The chapter discusses each finding with an emphasis on the implication of the findings for the EPWP programme as implemented by the Department of Environmental Affairs Working on Waste training and practice. Recommendations for improving practice, and recommendations for further research are tabled at the end. The chapter offers a model for improving the pedagogical process (i.e. semantics (SG/SD) to include fewer descending waves, and more attention to a more balanced ascending-descending semantic gravity pattern that can align with the strong epistemic code (ER+) emphasised by the field, and the EPWP programmes, while also giving attention to the strong social code (SR+) that workers bring to waste management knowledge. This chapter also reflects on the significance of the study and its contribution to new knowledge.

Chapter 2:

Conceptual and Theoretical Framing of the Study

2.1 INTRODUCTION

As outlined in Chapter 1, this study is located in the field of environmental education. It has an interest in workplace learning, and concerns about knowledge in workplace oriented training and learning. It is located in the context of Expanded Public Works Training at Level 2 on the South African NQF. This area is under-researched and little is known about the structure of waste management knowledge, as well as how knowledge circulates and is recontextualised in environmental learning contexts in this context.

The purpose of this chapter is to examine the conceptual and theoretical literature relevant to the problem being investigated (see section 1.2. of Chapter 1). The chapter is structured into two sections. The first section discusses issues relating to work, learning and workplace learning as this is the key educational context and focus of this study (sections 2.1 - 2.2.3) as discussed in section 1.2.2.4 of Chapter 1. The second section (sections 2.3.4 and 2.3.5) discusses the theoretical frameworks which guide the study and its interest in knowledge and knowers, and what and how knowledge circulates and is legitimated in the EPWP WoW training context.

2.2 WORK AND LEARNING

2.2.1 The Broader Context

When organisations recruit workforce members they place adverts which identify qualifications, knowledge specifications and skills relevant to the posts. The qualifying candidates apply, are shortlisted and are interviewed and the job is offered to the best qualifying candidate. However, Brown (2001) commented that those academic degrees, qualifications, skills certificates and documentation which provides access to employment are significant only at the time of the job offer and acceptance. The knowledge and skills people have on that day can be obsolete the following year because of global competition and rapid societal and workplace changes. Brown (2001) also pointed out that society has become reflexive and knowledge that people acquire is no longer static or fixed. Individuals are therefore under

increasing pressure to learn new skills and knowledge so that they can cope with the changes in the world around them.

Some workers that have dropped out of school do not have skills or certification credentials that can enable them to move up the ladder in the workplace, while others face challenges of reflexively responding to ongoing change in the environments surrounding their work. Continuous learning and lifelong learning have therefore been found as key to ensure ongoing employment of workers, to keep their skills up to date, technologically current and relevant to their employing organisations and the wider social and ecological context. These scenarios have given rise to governments, workplaces and workers' call for training and development in the workplace. In literature, this emphasis on learning in workplaces is termed *workplace learning* (Boud & Garrick, 1999; Billet, 2001). Demand for workplace learning is critical in the environmental field as global environmental change drives and demands companies and organisations such as municipalities to be more effective in responding to environmental concerns as these emerge in workplaces and wider society.

2.3 VIEWS ON LEARNING

The demand for workplace learning highlights change as a crucial aspect of learning. This requires a wider understanding of learning, and the meanings ascribed to the concept of learning. According to Tinnabutr (2009) learning is not simply behaviour modification, but involves engaged curiosity in order to improve efficiency. Jonsdottir (2006) claimed that learning can be seen as both a product and a process. He explained that learning perceived as a product is mostly viewed as the outcome of formal education in which competencies are acquired which change individuals or organisational performance. Jonsdottir (2006) saw learning as a process as informal learning which refers to learning outside formal structured institutionally classroom-based activities. Of course, classroom based learning can also be seen in process terms, so this definition may be too coarse for a careful description of learning processes. Saljo's (1979) research in Ramsden (1992) on what learners understand by learning can help to provide further definition. Responses fell into five categories. Learning was explained as:

- Quantitative increase in knowledge,
- Acquiring information and knowing a lot,
- Memorising and storing information that can be reproduced,
- Acquiring facts, skills and methods,

- Making sense of abstract meanings which involves relating parts of the subject matter to each other and the real world,
- Interpreting and understanding reality in different ways.

In the first three categories of Saljo's study, learning is seen as something effected by a teacher on a learner, as a possession to be 'acquired', whereas in the last two it is depicted as something internal, involving meaning making in order to understand and engage in the real world.

Blacker (1995) claimed that there are different forms of learning; learning can be immediate and confined to a specific activity, for example learning involved in parenting and running a home. People refer to this form of learning as 'unconscious' or 'implicit' learning. Learning can be formalised and this arises in the process of facilitating learning but it is often educative rather than being an accumulation of experience. There is also consciousness of learning where people involved in it are aware that the task they are engaged in entails learning. Learning can also be unintentional or accidental and occurs as we walk through life. Blacker (1995) stated that all these contrasting ways of learning can appear in the same context – such as in the context of waste management learning and practice in EPWP contexts which are the focus of this study.

Shedding further light on our understanding of learning is the work of Brown, Collins and Duguid (1989) who argue that learning in itself is a socially constructed concept. It emerges from practical collaboration and depends upon communal discussions and interactions. They believe that the concept of learning is not only understood by a small number of people with specialised knowledge but rather that understanding of the concept of learning is ubiquitous, which often makes it difficult to research learning, as there are so many different conceptions of learning, ranging from the everyday understanding of learning, to more sophisticated, theoretically informed definitions of learning in diverse contexts.

According to Illeris (2003) learning involves three dimensions: the cognitive, the emotional and the social dimension. The cognitive involves mental acquisition of learning content, which is described as knowledge, or skills that develop the learning ability of the learner. The second dimension entails the emotional which includes mental energy, feelings and motivation. The third is the social dimension which involves social interactions such as participation, communication and co-operation amongst learners. It builds up the sociality of the learners. To Illeris (2003) learning implies the integration of these processes, by which he means integration

of external interaction processes between the learner and his or her social, cultural world and the internal process of acquisition and elaboration.

Based on the above discussion, this study will focus on both the formal and the informal type of workplace learning as well as cognitive, emotional and social dimensions of learning. Many theories deal with these processes separately, but this study will focus on researching learning as a phenomenon which integrates all these dimensions.

2.3.1 Workplace Learning

Marsick and Watkins (1990) and Garick (1998) indicated that learning as a process is informal and incidental. They suggested that informal learning is not structured in terms of objectives, learning time and learning support. In some cases, it may be intentional but in most cases it is unintentional. They classified workplace learning under the informal or unintentional form of learning. However, authors who focus on workplace learning (Malcolm, 2003 cited in Bottrup, 2006; Billet, 2002) do not concur with this explanation. Billet (2002, p. 56) asserted that "describing workplaces as informal is incorrect".

Jonsdottir (2006), Tinnabutr (2009), Collin (2006), and Billet (1996) stated that there are different definitions, different understandings and different meanings of workplace learning and it means different things to different people, and their definitions are not consistent to each other. Billet (1996) sees both workplaces and educational institutions as types of communities of practice where learning takes place. He further indicated that workplace learning is often unrecognised for what it is because people do not think of their job as learning as what they learn is their practice. They do not see their practice as a context for learning something else. According to Engeström (2007, p. 336), workplace learning has emerged as "an extension of educational research stepping beyond the confines of the institutions of learning". To him its main focus is on "improvement of the conditions of work practices and instruction" (Engeström, 2007, p. 336).

Adding to the complexity of workplace learning understandings are affiliations to theories of learning, and different approaches to workplace learning can be associated with a range of learning theories in education. Gherardi (1998) and Tinnabutr (2009) associated workplace learning with *acquisition* of knowledge which may be data, facts, skills, practical skills, values and attitudes by formal or informal means in workplaces. They suggested acquisition occurs through collaborative processes in which employers and employees address skills development

through social dialogues in the workplace. Lave and Wenger (1991) on the other hand, saw learning and knowledge as relational, a process which occurs relationally among and through other people; a process which is an integral part of practice in everyday life and work. The perception of this approach is that work creates opportunities for learning and development in and through participation in everyday activities. Sfard (1998) referred to these approaches using the concept of 'metaphors of learning' which she described as the cognitive / acquisition and the social / participation metaphor. She did not see learning as an 'either / or' process, but pointed out that "it is impossible to free the discourse of learning from either of the two metaphors" (Sfard, 1998, p. 7). She also indicated that "commitment to one at the expense of the other can lead to theoretical distortions" (p. 4). From this perspective it would seem to be important to consider both the acquisition and the participation dynamics of learning in EPWP waste management workplace learning contexts.

Extending this discourse is the work of Engeström (1987), that suggested that workplace learning involves questioning and changing of the learning systems which underlie the object of activity, a process that results in a change of the theory and activity in use (i.e. the object of activity). In this approach that is where the group begins to radically question the sense and meaning of their object of activity (e.g. waste management) and to construct a new object of activity (i.e. zero waste practices). It is critically reflective in nature and Engeström described this type of learning as developmental or expansive learning. It explicitly fosters innovative performance and transformation at work (Engeström, 2004).

In this research I do not work with the developmental or expansive learning approach to learning as the EPWP work and learning programmes do not enable such expansive learning approaches as they are bound by unit standards, and their purpose is to support acquisition of knowledge and participation in practices as in the descriptions of Sfard (1998). The purpose of this research is not to generatively innovate the performance of waste management practices in workplaces but rather to *critically understand* the current forms of training and how they are constructed and how knowledge is used and legitimated in these processes. The aim is therefore *critical understanding*, rather than formative interventionist generative research praxis. As noted in section 1.3 of Chapter 1, the aim of this research is to investigate knowledge used in the environmental practice workplaces and how that knowledge circulates amongst the workers in the environmental formal training activities and informal participation in expanded public works projects.

From the broader and more theoretical discussions above, it is possible to see that workplace learning consists of different forms of learning activities which can include the following:

- A skilled worker guiding the learner in carrying out an activity [participation],
- A worker is given a simple task and then moves progressively to more complex tasks [participation],
- A trainee works along an experienced worker to watch and learn sometimes [participation],
- One or more workers are identified as people to who trainees and other workers can go for advice [participation / acquisition],
- The organisation provides short courses at the work premises and trainers may be either from the organisation or an external partner [acquisition],
- The organisation provides information and communication events which have a learning component [acquisition],
- Employees are provided with resources from which they learn for themselves for example books, manuals, videos [acquisition],
- Suppliers of equipment provide training on how to use new machines [acquisition/ participation],
- Employees learn informally through discussions with customer's suppliers and other external parties [participation],
- Workers/learners work in a simulated environment, where they follow activities [participation], and/or
- A group of workers work together to identify how to improve their activities following critical analysis of these [expansive learning].

The list given above indicates that there are different types of workplace learning activities, and different ways in which workplace learning is mediated and different ways in which it is interpreted, and thus different ways that workplace learning can be supported and analysed. In this research these types or approaches to workplace learning were taken into consideration in each of the study contexts. As can be seen in Chapters 4-8, I was particularly interested in how workplace learning was structured and facilitated in each context and how the knowledge originally produced in the field of production circulated amongst the qualifications, learning programme and learning materials designers, facilitators, participants, experts and old timers to learners in the workplace (EPWP workers being trained at Level 2 on the NQF to improve waste management practices in South Africa.

Workplace learning discourse, as outlined above, is not without critique. Collin (2006) and Fuller and Unwin (2003) noted that workplace learning is not systematic; it is senseless, not well conceptualised and lacks comprehensive theorisation. They proposed that it may be unconscious and not be recognised, and that it cannot be easily accredited and used for formal qualifications. Critics describe workplace learning as 'informal, unstructured, incidental and practice bound' and suggest that workplace learning does not have qualified teachers and classroom-like interactions and has no written curriculum used to plan teachers' actions; the fact that it has no qualified teachers makes it 'inferior' to learning that takes place in institutions of learning (Collin, 2006, p. 404).

However, Jonsdottir (2006) disagreed with this point and argued that workplace learning by its nature entails both formal and informal types of learning, which is the focus of this study. As noted in Chapter 1, the workplace training mandate of the EPWP is understood as both on-the-job learning via participation in workplace activities and acquisition of new knowledge via formal training interventions and short courses. Jonsdottir (2006) and Tinnabutr (2009) concurred that both formal and informal environmental workplace learning can be transformed to increase productivity.

2.3.3 Workplace Learning in South Africa

Prior to 1994 workplace learning in South Africa was not regulated and was largely ad hoc according to the needs of companies concerned. The Wiehahn Commission of 1977 was appointed to investigate labour and training legislation in South Africa (Wiehahn, 1977) (see section 1.2 in Chapter 1). The investigations led to the establishment of the Manpower Training Act of 1981. It was discovered that the industrial training system had a legislative structure that was not synergistic, and its different aspects of the legislation were administered by different departments. There were many overlaps, gaps, and a lack of standardisation and coordination (ibid., p. 231).

In 2004 Kraak reported on this same context noting that artisan training was unable to meet the requirements of the time as it took a number of years for one to qualify. Artisan training demanded on-the-job training which was often unsupervised and unstructured. There was also an inadequacy of facilities during apprenticeship. Some employers were fixed on specific tasks which deprived artisans in training from developing a wider range of skills. Qualifications were highly fragmented with problems of certification, multiplicity of certifying bodies, racial

segregation and lack of articulation or links between the formal education system and the training system (Kraak, 2004).

Kraak (2004) explained that to remedy the problems of apprenticeships and artisan training, the National Training Board and the Human Resource Council advocated for education and training to be institutionally-based and both structured and monitored. This was to allow for broadening of skills to include cognitive elements. He reports further that despite the decision to remedy this, the problems of uncoordinated industrial training persisted as organizations tend to only train people to meet their own needs. Others were not willing to invest in training, but 'bought' trained workers from other organisations by offering them better salaries and bigger packages (Kraak, 2004, p. 50).

Due to the inadequacies of the earlier training system noted above, the Reconstruction and Development Programme policy framework of the first post-apartheid government (ANC, 1994) and the first post-apartheid White Paper on Education and Training (South Africa. DoE. 1995) recommended the establishment of a National Qualifications Framework (NQF) which was later promulgated via the South African Qualifications Act of 1995 (South Africa. SAQA. 1995). The NQF, as established in 1995, is based on principles of equity, access, portability and redress, and was intended to enable access to those previously denied adequate learning pathways. It was meant to include a significant programme on Recognition of Prior Learning, and to facilitate worker training and learning (South Africa. SAQA, 1995). The South African Qualifications Act of 1995 was later substituted by the revised National Qualifications Framework Act of 2008 (South Africa. Department of Higher Education [DoHET], 2008). This together with the earlier Skills Development Act of 1998 (South Africa. DoL. 1998) provided the legislative framework for guiding and regulating workplace learning in post-apartheid South Africa after 1994.

The Skills Development Act of 1998 (South Africa. DoL.1998) requires all companies with employees of over 50 to pay a 1% levy to fund skills development. This effectively brought a stronger focus on skills development into workplaces and also led to the establishment of the Sector Education and Training Authority (SETA) system. The main purpose of the 1998 Skills Development Act was to:

- Develop the skills of the South African workers,
- Improve the life of workers,
- Improve productivity in the workplace,

- Encourage the workers to use the workforce as an active learning environment,
- Assist the unemployed to enter the world of work. (South Africa. DoL,1998, p. 4)

Through the NQF and the Skills Development Act, the South African government realised the importance of workplace learning with an aim of improving the employment prospects of persons previously disadvantaged by unfair discrimination. Via these legislative measures they sought to ensure quality of education and training in workplaces through the SETA system, which is responsible for quality assurance of all workplace training programmes and learnerships, including those offered by the EPWP (South Africa, DoL, 1998, p. 4). This has led to the workplace being considered to be a valid space for learning. The South African Technology Network (2007) represented by (Engel-Hills, Garraway, Jacob, Volbrecht and Winberg) presents the workplace as both a learning resource and a benchmark of practice. Workers are exposed to both learning and work environments and by doing that they are acculturated to academic and workplace knowledge systems.

Groenewald (2007) conducted a study to understand the terms used in relation to workplace learning in South Africa today. He described workplace learning as a process of placing students in the workplace for hands-on experience. The following terms were identified in relation to this field: workplace learning; experiential learning; co-operative learning; work-based learning; and work-integrated learning. He described experiential learning as a key term in the discourse of workplace learning and it has learning from experience as its subject. Jarvis and Wilson (1999, p. 120, cited in Groenewald, 2007) defined experiential learning as an activity in which the learner has a primary experience with the reality being studied.

The South African Technology Network's (2007) position paper introduced what is termed 'work integrated learning', a concept which used to describe placement of students in appropriate workplaces for the purpose of gaining work experience in their fields in cooperation with the employers. In some cases, work integrated learning is used synonymously with experiential learning. Work integrated learning requires qualifications to incorporate periods of work that integrate with classroom study, and as such, work integrated learning should form part of the qualification and be appropriate for the purpose of the qualification. It must have learning outcomes and assessment criteria. Institutions offering the qualifications should place the learners in workplaces and its programmes need to be appropriately structured, supervised and assessed.

Boud and Solomon (2001) introduced what they call "work-based learning". It is comprised of three strands, learning *for* work; learning *at* work; and learning *through* work. Work-based learning involves acquisition of work-related knowledge and skills both in the university/training institution and in the workplace, as discussed in section 1.2.2.4. in Chapter 1. The Council of Higher Education in South Africa (2004) defines work-based learning as the application of theory in a work-based context which raises the question of what knowledge is taught and learned where and when. It also addresses specific competencies identified for the acquisition of a qualification that will make the learner employable and emphasises the involvement of employees, professional bodies and the academic staff in the assessment of learning.

From the literature quoted above, workplace learning discussed in South Africa tends to put emphasis mostly on formal and explicit workplace learning (theory to experience transfer). There is little reference to informal, implicit and tacit forms of knowledge as in other countries. Lastly, workplace learning discussed above emphasises practices/activities in higher education with little mention of the practices taking place in the lower levels and in SETA-related processes. Thus this research focuses on training activities and workplace learning in the lower levels of the pathways of the NQF. As mentioned in section 1.3.2, it does not focus on formal learning (within classrooms or formal training settings) only but also on learning that takes place in the EPWP workplace context and on how this learning takes place.

2.4 KNOWLEDGE PRINCIPLES, PRODUCTION AND RECONTEXTUALISATION

2.4.1 The Emergence of a Social Realist View of Knowledge

This research is guided by social realist theory, especially Basil Bernstein's social realist theory of knowledge, which was later developed into Legitimate Code Theory (LCT) by Karl Maton. These theoretical perspectives are helpful for understanding the core interest of this study, which seeks to understand the structures and circulation of knowledge of waste in EPWP WoW training and workplace learning contexts. Wheelahan indicated that "Bernstenian theory and Maton's social realism constitute complementary approaches that together provide insights into the structures of knowledge, the content of knowledge, and the knowers. To the writers above knowledge includes the social conditions under which knowledge is produced and the extent to which these processes are mediated" (2007, p. 638).

In order to understand the origins of the social realist approach to knowledge (Maton & Moore, 2010), it is helpful to commence with the tracing of other types of knowledge approaches, which helps to explain how the social realist approach to knowledge emerged. On the one hand according to Maton and Moore (2010) one can identify a neo-conservative approach to knowledge which has its roots in the monastic tradition. The role of knowledge in this approach is to produce respect for whatever is canonical (ordered by church decrees). It is not motivated by epistemological concerns but is rather inspired by the view that traditional discipline of learning promotes proper respect for authority and protects traditional values. This approach treats the best knowledge as 'given' and not as an outcome of a knowledge construction process, and thus this approach downplays the social and historical nature of knowledge. Curriculum consequences are that there is no need for theory of what should be included in curriculum or not. Curriculum is 'given' and authoritative. (Luckett, 2010; Moore & Young, 2010)

Traditional forms of neo-conservativism have been extended by technical-instrumentalist views of education, where the curriculum imperative is not educational in the traditional sense but is rather seen to be "supportive of what they see as the needs of the economy" (Moore & Young, 2010, p. 17). From this perspective, knowledge itself becomes a means to an end not an end in itself. Prior to 1970, such approaches were mainly confined to vocational education and training but in the last decade, this approach has been extended under neo-liberalism and is often used to structure curriculum according to the demand for employability of students, and in such a system, students are encouraged to mix academic and vocational subjects and competences (Moore & Young, 2010). This trajectory has also led to the emergence of competence-based models of education and training, and in South Africa these were introduced with the National Qualifications Framework which used outcomes-based education and unit standards as its organising principle.

On the other hand, also according to Maton and Moore (2010), one can identify a constructivist approach to knowledge, often supported by post modernists. Postmodernists treat the issue of knowledge as central. They, however, reduce knowledge hegemony and power (i.e. dominated by one social group). They assume that all knowledge is embedded in the interests of particular groups of knowers (Maton, 2000a) and therefore seek to provide support to disadvantaged groups whether they are ethnic, gender or social class based to uncover the power that is embedded in knowledge. They argue that knowledge is inseparable from how it is constructed,

proposing a constructivist view of knowledge. Such a view of knowledge sees knowledge as historical, socially plural, and shaped by power. According to postmodernists, knowledge whether based on professional expertise, research, or experience of particular groups, is of equal value. In their discussions they always bring arguments to the fore focussing on 'whose knowledge experience' should underpin the curriculum (Moore & Young, p. 21). The purpose of curriculum theory shaped by this view of knowledge becomes critical deconstruction of dominant forms of knowledge. This theory of curriculum does not separate knowledge and knowers but always makes it explicit that knowledge is always some people's knowledge and is therefore not neutral (Moore & Young, 2010, p. 15).

Associated with postmodern and constructivist views of knowledge is relativism. Relativists question the form and content of knowledge. They attack claims to objectify dominant forms of knowledge and they defend the voices of the denied or the hidden. They create a division between dominant knowledge and the knowledge of the silent. Debates on knowledge among relativists becomes a form of an 'attack or defence' between oppressors and the oppressed. The narrative is that communities are deprived of knowledge that goes beyond their experiences and that dominant knowledge excludes the knowledge of the marginalised (Luckett, 2010).

To develop a sociological critique of the emergence of diverse theories of knowledge and their limitations and implications for curriculum, theorists mentioned in the narrative above (Maton & Moore, 2010; Moore & Young, 2010; Luckett, 2010; Wheelahan, 2010; Allais, 2006 – all drawing on work of Durkheim, 1961 and Bernstein, 1990) importantly differentiate between the epistemological dilemma and the educational dilemma. The epistemological dilemma recognises that knowledge is either related to / or not related to the social and intellectual interests of the knower which means that the only choice of understanding of what knowledge is, lies between positivist absolutism and constructivist relativism. Here knowledge must be seen as decontextualised, value-free and objective or socially constructed within particular cultural and historical conditions. The educational dilemma indicates that knowledge is either given or is the result of the power struggles between competing groups, where one group includes and legitimises its knowledge while excluding that of the other groups (Alexander, 1995, p. 91) They see knowledge as the 'either/or' of this dilemma (Maton & Moore, 2010, p. 2).

According to Maton (2010), the major contribution of social realism in the sociology of education was to replace the 'either/or' with 'both/and' (ibid.). He interpreted this stance as

an alternative to reductionism and as a social critique of postmodernism. He suggested that social realism resolves the epistemological dilemma and the educational dilemma, as it recognises the social character of knowledge but is against constructivism and relativism. Social realism recognises that knowledge is produced in socio-historical contexts and is fallible (capable of being incomplete) rather than absolute or merely relative (considered in relation to). Social realism allows knowledge to be seen in its own right, not simply as a reflection of some truth or social power; knowledge being seen as having different forms has effects for intellectual and educational practices. Social realism puts knowledge centre-stage in education (Moore & Young, 2010; Maton & Moore, 2010).

Social realism recognises that knowledge is objective (and is not only influenced by personal feelings /opinions) and that it is "emergent from and not reducible to the contexts in which it is produced and acquired". To the social realist, "knowledge is not only social, it is also real" and some forms of knowledge "are more capable of cumulative knowledge building than others and some are more suited to the learning needs of some social groups than others" (Howard & Maton, 2011, p. 194).

Social realist theory is termed social because it argues that all knowledge is socially produced by communities of knowledge producers and is realist in the sense that it argues that knowledge is about an objective world. As such, knowledge exists independently of our social constructions of it and the world is made up of the social and the natural world. Academic disciplines and fields are used to navigate these boundaries. Contemporary educational social realists such as Moore and Maton draw on the work of Bernstein (2000) who explained the tacit metaphor structuring his work as the notion of boundaries (Muller, 2000, p. 76). In this work, the crucial factor in this metaphor is what the boundary signifies (Wheelahan, 2010, p. 8).

Bernstein and Solomon (1999) explained the origin of the concept of the boundary. Boundaries are created by the unequal distribution of capital (currencies available to actors in their struggle for power, authority and status) in society. The boundaries can be crossed by some and not crossed by others. Boundaries create insiders and outsiders which are defined in opposition to one another. These boundaries are primarily symbolic, as they refer to the ways dominant structures and enduring practices work to keep certain domains of knowledge or social groups apart. The boundaries can enable and disable knowledge building. Muller (2000, p. 71) explained that the metaphor (boundaries) is enabling only if the boundaries are recognised and

navigated. He argued that students must be provided with the capacity to navigate the boundaries, thus arguing for the structure of knowledge to be made explicit to them. Social realists argue that a key to the recognition and navigation of boundaries is for students to be equipped with the ability to gain access to theoretical knowledge by being aware of the navigation between theoretical and everyday knowledge, and for this the boundaries of theoretical knowledge need to be made explicit; they should not be conflated with everyday knowledge. For waste management training, this would imply that the systematically and scientific boundaries of formal, theoretical knowledge about waste should be made explicit to workers and should be differentiated from their everyday knowledge. This should allow them to gain access to theoretical knowledge about waste management and according to social realists, this form of education is more empowering.

Social realism is based on key critical realist philosophical terms which include ontological realism, epistemological relativism and judgemental rationality (Maton, 2010; Archer, 1998). Ontological realism involves the recognition that knowledge is about something other than itself and there exists a reality beyond the symbolic realm. This does not suggest that knowledge is an unmediated reflection of reality but rather it suggests that knowledge is more than the arbitrary expression of power relations (Maton, 2010).

As explained by Bhaskar (1998), epistemological relativism acknowledges that knowledge of the world is not necessarily universal or invariant. Knowledge in the world is socially produced and changes over time and differs across socio-cultural historical contexts. Knowledge of the world is fallible and can change as better or different explanations of the world are produced. Judgemental rationality does not entail judgemental relativism which is the notion that judgements among different points of view are not possible. It suggests that there are intersubjective bases for determining the relative merits of compelling claims to insights; it is possible to make value-judgements and claims – not all knowledge is equally valuable or valid, and judgements need to be made in social contexts and in relation to ontological referents. For example, we can suggest that managing waste is a good thing to do (value judgement) as it harms people's health and the environment (ontological referent), but there may be a range of different ways or scientific theories associated with how the waste may best be managed (epistemological relativism). Decisions as to which of these theories are most useful to people often involve a weighing up of the knowledge in relation to the knowledge itself (i.e. it might be a better theory), context, culture and other ontological and socio-cultural factors. The ideas

above highlight that we construct knowledge of the world, but we do not construct it the way we like or as we please, not perfectly and also not free from worldly referents or consequences. (Moore & Maton, 2010). This also implies that knowledge is not constructed by actors arbitrarily according to how they fancy, but rather via deliberation and testing of existing knowledge in relation to current realities and the socially situated experience of the actors concerned. This is an indication that when one studies issues of knowledge, one needs to explore how knowledges came to be defined in particular social and historical contexts, and to understand the forms and effects of this knowledge. As noted above in the short overview of the evolution of waste management knowledge (see section 1.2.3), there is a clear shift in discourses around waste management in policy, which reflect changes in knowledge production around how best to manage waste. As also shown in the section above, in the African context, it is not knowledge alone that is needed for waste management improvements, but there are other ontological, and situational factors that influence how this knowledge is realised in practice (e.g. urbanisation patterns, structural infrastructure support and so on). In Chapter 4 I explore the nature of, the forms of, and how waste management knowledge has been developed by different actors in the field over time to explicate this further.

From the above, it is clear that social realists believe that knowledge is irreducible to the practices and contexts of its production, recontextualisation, teaching and learning. It involves more than social power as it also involves epistemic power. It is socially produced but can also transcend / surpass the social conditions under which it is produced (Moore & Young 2010; Maton & Moore 2010. Social realist theory also reveals that different forms of knowledge have their own properties, powers and tendencies which shape the ongoing struggles around knowledge. Some forms of knowledge are more capable of cumulative knowledge building than others and some are more suited to the learning needs of some learners than others (Howard & Maton, 2011, p. 194).

2.4.2 Knowledge Practices and Principles – The Earlier Work of Bernstein

In their social realist research, Maton and Moore (2010), along with other social realist educational sociologists, were calling for attention to be given to the study of knowledge practices. They were not only seeking out empirical descriptions of knowledge practices but also "to analyse the principles underlying those practices" (Howard & Maton, 2011, p. 194). In this work they built on Bernstein's earlier work (2000, pp. 155-174) that outlined a way of conceptualising diversity in the structuring of knowledge. Bernstein firstly distinguished

between forms of discourses. According to Bernstein (2000, cited by Maton, 2009) knowledge is divided into vertical and horizontal discourses, as outlined in Table 2.1 below.

Table 2.1: Vertical and horizontal discourse (Source: Maton, 2009, p. 44)

Vertical discourse	**Horizontal discourse**
Specialised and symbolic knowledge	Everyday knowledge
Coherent and explicit knowledge	Common sense knowledge
Scholarly, educational and professional knowledge	Entails a set of strategies which are local, segmentally organised, context-based and specific and dependent on context
Meaning is less dependent on relevance to the context	Typically tacit
Takes a form of coherent, explicit and systematically principled structure	Knowledge arising out of common problems of living and dying
Develops through integration and subsumption of knowledge	Lacks explicit integration/ coordination
Meaning is related to other meanings hierarchically	Carried out in face-to-face situations

Bernstein (2000) also distinguished between hierarchical and horizontal knowledge structures as outlined in Table 2.2 below.

Table 2.2: Hierarchical and horizontal knowledge structures (Source: Bernstein, 2000, pp. 155-174)

Hierarchical knowledge structure	**Horizontal knowledge structure**
Illustrated by sciences	Illustrated by humanities and social sciences
Coherent, explicit and principled structure	Contain series of specialised languages with specialised modes of interrogation and criteria for the construction and circulation of texts
Attempts to create general propositions and theories	Knowledge structures develop through adding segmented approach or topic area
Integrates knowledge at the lower levels	New ideas are developed alongside than being built on past knowledge

Integrates and subsumes previous knowledge	

Bernstein (2000, p. 54) further distinguished knowledge into singulars, regions and generic modes. 'Singulars' are comprised of academic disciplines. They have specialised knowledge structures (Bernstein, 2000, p. 54). They were established at a time when there was a need for specialised knowledge among differentiated divisions of labour i.e. mainly under modernisation, which has been increasingly characterised by specialisation of knowledge and specialisation in labour patterns and practices. Examples of 'singulars' are well established scientific disciplines of Physics, Psychology, Sociology, Mathematics and so on.

'Regions', as explained by Bernstein (2000, p. 52) are at the interface between academic disciplines (singulars) and the field of practice for which students are prepared. Environmental education is a typical 'region' as it lies at the interface of the environmental sciences and the field of practice that involves societal changes. It is referred to as applied disciplinary knowledge which underpins professional and vocational practice (Young, 2006, p. 55). Regions draw on, integrate and recontextualise knowledge as the theoretical basis of practice in occupations and professions. Growth of regions is associated with growth of professions (Wheelahan, 2010, p. 24).

The third type of knowledge described by Bernstein is the generic mode. The generic mode of knowledge relies less on the academic disciplines for a knowledge base. Its knowledge base is related more to relevance to the market, which provides the principle for selecting knowledge for the field of practice (Bernstein, 2000, p. 53). Marketing, is a typical example of a 'generic mode' form of knowledge.

The different types of knowledge discussed above are useful for describing the nature of waste management knowledge and especially helped me to describe the principles of waste management knowledge (see Chapter 4). I was thus more equipped to interpret and make sense of the way in which knowledge circulates in the WoW programme.

2.4.3 Recontextualising Knowledge in Education

As argued by Bernstein in his sociology of education and his description of the pedagogic device, it is not only the structure of knowledge that is important to education, but also how

knowledge is transformed via recontextualisation processes. Maton and Muller (2006) and McNamara (2009) noted that Pierre Bourdieu and Basil Bernstein both made significant contributions to the project of making the central role of knowledge visible in education, especially also through their descriptions of how knowledge is worked with in education, and how such processes produce inclusions and exclusions. I touch on each of their research programmes here, in order to provide the background to the more recent work of Karl Maton, whose Legitimate Code Theory helped me to interpret waste management knowledge and its circulation in the WoW programme.

Production and recontextualisation of knowledge are processes embraced in Bernstein's theory of the pedagogic device (1990; 1996) which enables a systematic and in-depth analysis of the production, development and implementation of curriculum (Bernstein, 1990; Singh, 2002). According to Bernstein (2000), the structure of the pedagogic system consists of three hierarchically related fields, namely that of production, recontextualisation and reproduction. The production field represents the intellectual field of the system, where individual researchers and research groups at various universities and research institutions produce new ideas, theories and specialised discourses (e.g. ideas, theories and specialised discourses related to waste management such as those reflected in policy reviewed above in section 2.4). Texts produced by this field include academic articles and reference books. For this study, it was therefore important to know the type of waste management knowledge that has been produced and created by the above processes and made available to the WoW programme and workplaces, the social division of labour involved, and relationships that exist between those involved in the production of the knowledge as this helps to explain and critically analyse knowledge production i.e. the knowledge that is then used to structure educational programmes and processes.

The recontextualising field denotes the field where the specialist discourses produced in the field of production are selected, decoded and simplified for use in other contexts (Bernstein, 1990). According to Bernstein (ibid.), the main activity in this field is to control the "what" and the "how" of pedagogic discourse, by controlling the construction of pedagogic texts and practices, respectively. In his explanatory project, Bernstein divided this field into two sub-sections namely the official recontextualising field (ORF) and the pedagogic recontextualising field (PRF). Examples of agencies that are active in the official recontextualising field include specialist departments and sub-agencies of the state (e.g. the Department of Higher Education

and Training, or the Department of Environmental Affairs), together with local education authorities (e.g. the Sector Education and Training Authorities) and curriculum support staff who work in such institutions. Texts produced by agents and agencies in this field form the official pedagogic discourse, which includes the constitution of the national curriculum, subject syllabi, unit standards, assessment guidelines and curriculum guides. University and college education departments, teachers and vocational education colleges, specialist education media, education journals, publishing houses, the Sector Education and Training providers, their readers and advisers make up the pedagogic recontextualising field. They all have various roles to play in recontextualising the knowledge that emerges in the Field of Production, especially related to knowledge selection (i.e. what they prescribe in unit standards, for example) or what they include in training materials, and pedagogy (i.e. approaches that are used to support learners to make sense of, access and use the knowledge that has been selected). There is often a relationship between the ORF and PRF. For example, the Field of Production might be producing new knowledge of cradle-to-grave or life cycle approaches to waste elimination and management (produced in the Field of Production), which would be included in the prescribed unit standards (produced in the ORF) and potentially also in the training manuals (produced in the PRF). However, along this sociological pathway, meanings or aspects of this knowledge as produced in the Field of Production may change significantly, depending on the selections, interpretations and ideological transformations enacted in the ORF and PRF (Ramsarup, 2005). For example, Ramsarup's (2005) thesis showed how environmental knowledge produced in the field of production in South Africa, was significantly transformed by ideological perspectives of post-apartheid state actors in the ORF (which imbued this knowledge with a human rights / social justice interest), and then significantly transformed again by NGO actors in the PRF (who emphasised active engagement with this knowledge), and by actors in the Field of Reproduction (i.e. where the knowledge is taken up and used by learners) (whose interest in improved livelihoods significantly transformed the environmental knowledge again).

The educational sociology of Bourdieu (1990) helps to explain some of these transformations as his work emphasises culture and its influence in education. He explained how culture and various forms of capital including social, cultural and economic capital structures engagement in fields (e.g. the field of waste management), which in turn influences inclusions and exclusions in the same field. For example, scientists with high levels of economic, social and cultural capital are able to produce new knowledge of waste management, while workers such

as those in the EPWP programmes have access to different types of social and cultural capital that may not match the 'mainstream' of waste management discourse. They also have lower levels of economic capital, affecting their engagement with waste management issues (i.e. many are 'forced' into this via the need for income that comes available in the WoW programmes) whereas the scientists may choose to become more involved in various specialisms associated with waste management. Bourdieu's work also highlights the way in which cultural capital, which he also describes in terms of the 'habitus' i.e. that which becomes encultured in our practices, influences educational responses to knowledge. For example, we may be encultured into the concept that waste will be managed by 'someone out there' and are therefore not concerned about what we do with our waste. This would influence how we respond to waste management education and programmes such as the WoW programme.

Thus, in seeking to understand how knowledge circulates in education, the work of both Bernstein and Bourdieu are helpful, as they help to explain how sociological contexts and realities, as well as how historically situated power relations shape the movement, recontextualisation and reproduction or reception of knowledge. These social relations influencing knowledge and its reception and uptake are as significant to a social realist perspective on knowledge as the understanding that knowledge has a wider history and genesis that only that which we can make sense of at a given point in time or situation. In South Africa, workers in EPWP programmes, via circumstances associated with poverty and poor quality education, have systemically been disenfranchised over time. This would seem to be an important consideration in the conceptualisation of a social realist perspective on education and training that puts knowledge at the centre, as in this study. From the above, it is clear to see that knowledge recontextualisation is not a simple matter of 'knowledge transfers', and thus this sociological process needs to be probed more carefully, also in worker training at elementary occupation levels, as in this study.

2.4.4 Critique of Bernstein's Work and Development of Maton's Legitimate Code Theory

2.4.4.1 Expanding Bernstein's work

Muller (2000, p. 65) assessed Bernstein's work critically. He maintained that Bernstein's concepts remain 'locked into' an early, lexical (relating to words), metaphorical stage of discussion where the concepts are more suggestive than they are explanatory. Bernstein offered dichotomous ideal types whose differences are too strongly drawn. This, he suggested, causes one to raise many questions like (which are of relevance to this study):

- Whether the horizontal discourses are the same;
- Whether there are any shifts between discourses or from one discourse to another;
- Whether there are any shifts between the two forms of knowledge structures;
- What makes a discourse horizontal or vertical?
- What makes a knowledge structure hierarchical or horizontal?

To this I would add:

- What creates the boundaries of a 'region'?
  This is of particular interest to this study, which seeks to consider how specialist knowledge of waste management circulates and influences the field of waste management practice at elementary occupation level.

In response to critiques of his theory such as those raised by Muller (2000), Bernstein stated that his concepts represented a provisional mapping of intellectual fields, meaning that his notion of knowledge structures was not the end of the matter, it was open to and invited better research, or to be developed further. This declaration opened a door for other specialists in social realism to build on and improve Bernstein's theory.

As noted above, the social realists had an interest in analysis and theorising of "the underlying principles underlying knowledge practices for example, discourses, knowledge structures, curriculum structures and forms of teaching and learning" (Howard & Maton, 2011, p. 194). As indicated in Chapter 1, in this study principles underlying the knowledge practices of waste management at the level of production (Chapter 4), recontextualisation (Chapter 5) and reproduction (Chapter 7) are explored, inclusive of the underlying structuring principles that govern the basis and measures of legitimacy within the field.

Maton (2010) developed the concept of legitimation from Bernstein and Bourdieu's earlier work and explained that languages of legitimation embody messages as to what should count as legitimate knowledge within a field and who participates in it. McNamara (2007) confirmed that codes, devices, classification and framing are key concepts of Bernstein's work, while fields, capital and habitus are key concepts from Bourdieu's corpus of scholarship. These are integrated into the Legitimate Code Theory of Maton (2010).

Classification measures the degree of insulation between fields, discourses and habitus. Classification was used by Bernstein (1971) to conceptualise power. He noted that power erects and sustains boundaries between different disciplines / groups and also legitimises their delineation and distinctiveness with respect to one another . Classification may be stronger or weaker. Classification is represented by C. Stronger classification is represented by + (plus) while weaker classification is represented by – (minus). Stronger classification C+ implies stronger boundaries between categories/fields. Weaker classification C- means those boundaries are blurred or have become permeable. Classification constitutes voice (what is appropriate) and regulates what counts as legitimate discourse or discipline. According to Bernstein's sociology, control is conceptualised as framing. It is concerned with regulation and control of practices. Framing is represented by symbol F. It may be stronger F+ or weaker F-. Control relations establish legitimate communication between categories or fields and framing relates to how communication takes place between the acquirer and the transmitter of knowledge. When the framing is stronger F+, the transmitter is in control of the communication and when the framing is weaker F-, the acquirer is perceived as in apparent control (Carvalho & Dong, 2007).

The concepts above form the foundations of Maton (2005)'s Legitimation Code Theory (LCT). Maton (2005) developed a conceptual framework which integrates/ embraces the insights of both Bernstein and Bourdieu. He unpacked and integrated the principles of their earlier theoretical work in the development of LCT. LCT (Maton, 2000, 2004, 2006) thus expanded the work of Bernstein (1975) and Bourdieu (1984, 1985, 1986 1990, 1993) Maton's theory of legitimation code theory and epistemic device is postulated as the means whereby intellectual fields/ educational fields are maintained, reproduced, transformed and changed (Maton & Moore, 2001). It is comprised of the language of legitimation codes and the principles of legitimation. Knowledge and practices in the intellectual fields are conceived as languages of legitimation. The underlying principles structuring these practices are conceptualised as legitimation codes which bring together sociological and epistemological understandings of knowledge. Maton (2007) argued that the intellectual and educational fields are more than knowledge structures as discussed by Bernstein; they also include a structure of knowers. He believed that for every knowledge structure there is a knower structure. He showed how the two can be brought together and how their underlying structuring principles can be analysed.

Maton's (2007) LCT is based on his consideration of the 'two cultures' debates on relations between science and humanities which was opened by C.P. Snow's lecture in 1959. Snow (1959, as cited by Maton, 2010) argued that intellectual life of Western society was split into two 'polar groups' that ceased to communicate between each other. His two cultures were associated and interpreted as humanities and sciences. Scientific culture was portrayed as enjoying a meteoric rise in stature while humanities were portrayed as embattled, in decline and insecure. This struggle over status became violent and bitter and still remains a bone of contention to this today.

Maton (2008, p. 89) tried to answer why there was such a struggle. He stated that scientists and humanists spoke different languages that were based on different knowledge structures and interests. He suggested that the solution to this predicament is not by looking at the different languages but rather can be better understood by focusing on the underlying structuring principles of their languages which he did by exploring them using knowledge and knower structures. He differentiated between humanistic and scientific knowledge structures, which are derived from a reading of the 'divide' between the natural and social sciences, the emergence of which characterises knowledge structuring in the 19th and 20th century in modern institutions. This form of knowledge structuring accompanied the emergence of modernity and the rise of the industrial revolution, advances in medicine and human rights, all of which also drove a culture of expanded humanitarianism and the emergence of the social sciences. The knowledge structuring debate, interesting for this study, stops short of the recent emergence of an emphasis and need for inter-disciplinarity and trans-disciplinarity in response to wicked environmental problems that require at the very least more co-operation between disciplines and types of knowledge to resolve their complexity (Bhaskar, 2010).

Interdisciplinarity, Multi-disciplinarity and Intradiscplinarity

Waste management, like other environmental problems, is complex, interdisciplinary and multidisciplinary. According to Thompson (1990), interdisciplinary involves a number of ideas, for example ideas of unification, synthesis and integration of knowledge. It is a process which involves integration of different mechanisms. Sometimes it is derived from a conviction that some disciplines are unable to address important challenges encountered with them. Interdisciplinarity brings a solution to that predicament and brings together components of two or more disciplines to bring a solution to the challenge. In the process, it creates something new by thinking across traditional boundaries and disciplines meld and new professions emerge.

Waste management came up as result of that integration of knowledge from different disciplines with multiple mechanisms and processes at different levels. Integration lead to emergence of new levels and outcomes. New levels and outcomes lead to the interlinking and interconnecting of different outcomes. Integrations of these mechanisms as well as emergences are affected by the contexts in which they work which therefore lead to the alteration and change of mechanisms. When mechanisms change we talk of intradisciplinarity. Multidisciplinarity involves drawing from multiple academic disciplines to define problems outside disciplines and reach solutions. Bhaskar (2010, pp. 4-5) suggested that interdisciplinarity and intradisciplinarity are relevant and crucial to address the complexity in climate change and environmental problems. Waste management is not an exception as it is one of the complex environmental phenomena discussed. Onto Bhaskar's (2010) suggestion, I add multidisciplinarity. Interdisciplinarity, intradisciplinary and multidisciplinarity will therefore be used to discuss complexities in waste management knowledge.

2.4.4.2 Humanities and Scientific Cultures and Knowledge Structures

Maton (2008) drew a parallel between humanities culture and its characteristics and Bernstein's descriptions of horizontal knowledge structures. This knowledge structure (and culture) is comprised of a series of segmented and strongly bounded languages. Further, the humanities culture is divided into sub-cultures, those which possess stronger grammars and those which possess weaker grammars. Stronger grammars have an explicit conceptual syntax capable of empirical descriptions e.g. linguistics and economics. Weaker grammars are expressed as immersion in the best that has been known in the world and their examples are anthropology, cultural studies and sociology. Thus, perhaps counter-intuitively, the humanistic knowledge structure is strongly bounded, yet horizontally inclined, and can therefore exclude proponents who are not familiar with the discourses of the field more easily.

According to Maton (2008), scientific culture claims that science is comprised of an organic community with shared common attitudes, common standards and patterns of behaviour. They are portrayed as integrated and whole, and are reliant on the vertical structuring of scientific and mathematical knowledge which is made very explicit. Though proliferating new knowledge and sub-disciplines, they have been identified as having an ability to know how to integrate the disciplines they develop. This knowledge culture, according to Maton (2008) resembles what Bernstein describes as a hierarchical knowledge structure. It develops through the integration of knowledge at lower levels and across a range of phenomena. Those in the

field are more able to progress along a clearly defined, more established and predictable vertical path.

2.4.4.3 Humanities and Scientific Cultures and Knower Structures

Importantly, and differently to Bernstein, Maton also gives attention to *knower structures*, not only the structures and structuring of knowledge. In developing his thesis of knower structures and how they interface with knowledge structures (humanities and scientific as outlined above), Maton (2008) utilised the concept of knower structure to understand their underlying principles. He commenced by looking at the humanities culture which was portrayed as having emerged as a common knowledge culture underpinned by classics. Maton (2008) argued that it is not classic skills, techniques and procedures that integrated classics humanities into a culture, but rather the dispositions that classical education was guaranteeing. Humanities intellectuals were seen as 'gentlemen amateurs' who pursued their studies for the love of it. They were viewed as secondary to clergy and prioritised cultivating a 'cultured sensibility' of 'an English gentleman' amongst the students. They were selected on the basis of fitting the culture of a university and their aim was to humanise, whose underpinning claim was an image of what is meant to be human in the views of the English gentile. Thus, such knowers bear the sensibilities, character and personal attributes of an ideal humanities knower. The basis of their specialisation was not knowledge but rather the habitus or dispositions of an ideal knower. Classics was a shorthand for these dispositions. To be educated in classics was to have a particular social and educational trajectory. One needed to be typically male, higher social class and may have studied in a private school. The humanities culture exhibited a hierarchical knower structure and a systematically principled and hierarchical organisation of knowers based on the image of an ideal knower. This knower structure therefore relies on being part of a particular class of knowers and an unspoken 'shared' understanding of culture and what counts as 'good' knowledge and practices, mainly defined by the English white male, upper class 'elite'. This type of ideal knower develops through the integration of new knowers at lower levels and across an expanding range of different innate, social dispositions. In short, one needs to be part of the 'inner circle' to understand and participate in such a knowledge system and it can be alienating and exclusionary of those that are not from the same class, race or historical background. Counter-intuitively, a horizontal knowledge structure requires a vertical knower structure. This has implications for social justice issues and access issues in education as shown by LCT studies in Australia by Chen (2010). Chen (2010) undertook his study in the use of online learning by Chinese students in an Australian University which was

to them a foreign university. He used specialisation to understand the underlying principles guiding their learning in a foreign country. He realised that the knowledge code brought by these students from their previous education system was limiting their success in online learning in Australia. It resulted in anxiety, alienation, depression and disengagement among students. There was a code clash between their previous learning methods and the ones used in online learning in Australia. They suffered exclusion in a curriculum they were expected to excel in.

As noted above, scientific knowledge is independent of the personal merits of its possessor. The basis of specialisation in science is knowledge of scientific procedures, regardless of social background. Maton described science as possessing a horizontal knower structure with a series of bonded knowers. Each scientific field has its own specialised modes of being and acting based mainly on its knowledge content and structure. The differentiated and specialised sciences (e.g. mathematics, biology, physics) had non-comparable habituses based on different biological and social backgrounds and histories. They represent a series of segmented knowers who are not differentiated according to their social class and sensibilities related to 'what counts' in cultural circles, but rather according to their grasp of the vertically structured technicalities of the knowledge field. Thus, counter-intuitively, a vertical knowledge structure requires a horizontal knower structure.

2.4.4.4 LCT and the Principles of Specialisation and Semantics

Based on the discussions and experiments above, Maton developed his theoretical framework called the Legitimation Code Theory (LCT). It is a practical theory which is used in empirical research to provide explanations for problems that arise in education around knowledge and its circulation and uptake. It analyses the basis of achievement using underlying social contexts as a means of understanding practice (Maton, 2000; 2007; 2010). It views practices of educational agents as embodying languages of legitimation. The practice of these educators, which involve knowledge recontextualisation processes, may be curriculum development, pedagogy, evaluation, expression of educational beliefs and or shaping and contributing to classroom interactions. Maton proposed that the organising principles underlying all these educational practices and the knowledge recontextualisation and uptake processes, can be conceptualised as legitimation codes which can be analysed along a number of dimensions to make these practices and their principles more visible. Ultimately, besides advancing educational analysis, Maton's aim appears to be to enable educators to become more reflexive of their practices and

to understand the way in which their practices are structured, often without their conscious understanding of these legitimation codes and principles. His (and other LCT researchers' theses) appears to be that such an approach to educational analysis can potentially strengthen social justice and inclusivity in education, an issue which I will reflect on at the end of this study (see Chapter 8).

The LCT is a living and expanding theoretical project (see www.legitimatecodetheory). Overall, it is comprised of five principal dimensions, namely autonomy, density, specialisation, temporality and semantics (Maton, 2010). All these help to explain the principles of the knowledge and knower structures that underpin education, training and pedagogical practices. Only two dimensions of LCT are used in this study, namely *specialisation* and *semantics*, as they are most useful in addressing the study's interest in how waste management knowledge develops and circulates in WoW programmes.

Maton (2007, p. 97) explained specialisation as being based on answers to the following question:

> What makes actors, discourses, and practices special or legitimate in an intellectual/ educational field?" Specialisation is conceptualised in terms of the epistemic relation (ER) and the social relation (SR). If the level of legitimacy is based on mastery of specialised knowledge, procedures, techniques or skills, it is knowledge-based and has a strong epistemic relation relative to a social relation (ER+, SR-) i.e. a strong *knowledge code*. If the relation is based on social relations e.g. learners' dispositions i.e. inherent qualities of mind and character, the social relation is stronger and the epistemic relation is weaker, leading to a strong *knower code* (SR+ ER-).

If neither of the two are strong it is described as a *relativist code* and if both the knowledge and knower code are strong, it is described as an *elite code.* This continua of strengths is visualised and represented as X and Y axes of a Cartesian plane in which the four strengths are identified. Figure 2.1 below shows an example of the analytical framework depicted graphically.

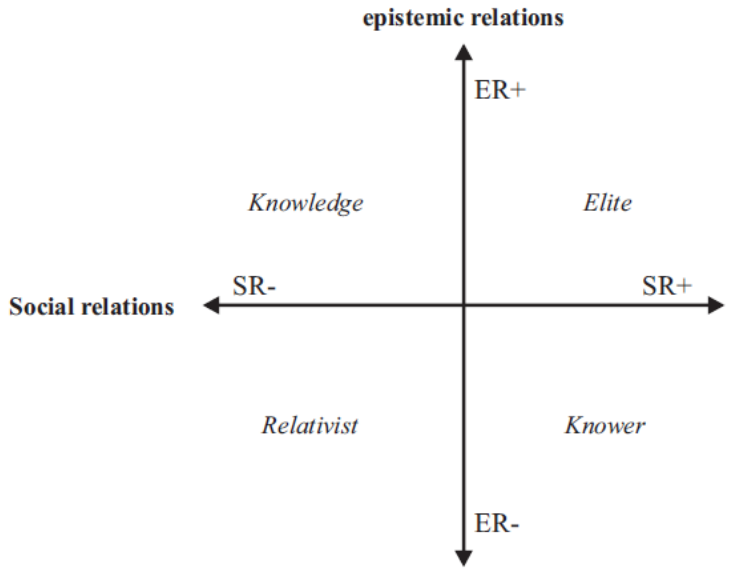


Figure 2.1: Specialisation codes of legitimation (Source: Maton, 2007, p. 97)

These concepts are used to investigate intellectual and educational fields. Specialisation has been used in a number of educational studies to investigate the basis of or the dominant achievement of a field which indicates what makes that field different, special and worthy of distinction from others, for example Calvalho and Dong (2007) undertook a study examining perceptions of achievement in design disciplines, namely engineering, architecture, digital media and fashion design. They realised that though these disciplines were classified under design, they emphasised different perceptions of achievement. They discovered that engineering emphasised technical, scientific and mathematical knowledge, architecture a combination of passion, creativity and tenacity while in fashion design, participants always have a sensation inside which is pushing them to do it. They always express that they have an inner calling. These findings depicted that engineering emphasised the knowledge code, architecture, the knower code and fashion design, the knower code. This realisation assisted the lecturers to adapt their approaches to the pedagogy utilised. Lamont and Maton (2008) picked up that in English schools, the school music curriculum became unpopular as the learners progressed at school. They undertook a study to assess the underlying principles influencing this using specialisation. They realised that the dominant code changed as the curriculum progressed. The school music curriculum shifted from knower code at primary schooling to knowledge code at secondary schooling. Howard and Maton (2011) conducted a study on the integration of information and communication technologies (ICTs) in English and Mathematics. It had been realised that ICTs were integrated differently across the disciplines,

some subject areas showed more integration of technology than others. Using specialisation, they analysed the organising principles underlying knowledge in maths and English as well as the ones underlying to policy framework of the integration initiative and compared the three. They discovered that there was a code clash between the policy aims and the knowledge practises dominating maths while there were code matches between policy aims and knowledge practises in English. This helped Howard and Maton (2011) explain how integration can be dealt with in different disciplines. These studies helped me to understand the nature of waste management knowledge in the field of environmental science which integrates disciplines. Maton claimed that fields should be understood as knowledge-knower structures, as he believed that for every knowledge structure, there is a knower structure. That means that knowledge claims and practices are comprised of two relations, namely the epistemic relation of knowledge to the object/ and the social relation to the subject /author/ actor. Different practices may emphasise these two relations differently and these may be represented as being stronger or weaker. That means knowledge can be seen as specialised by its epistemic relation, social relation, both epistemic and social relation and by neither epistemic or social, depending on its specific structure. The implications of these relations are different for different fields, and in this study, I hope to derive insight into what kinds of combinations may best inform effective waste management education and training for workers in the WoW programmes. My interest, as noted in Chapter 1, is also aligned with of inclusion of workers in the practice of waste management. Maton's concept of specialisation as explained above, which is inclusive of both knowledge and knower structures, is used in this study to guide the understanding of knowledge production and its recontextualisation and reproduction. I examine the structure of waste management knowledge and the structure of elementary occupation waste management knower structures, as relevant to the waste management practices in environmental EPWP workplace training activities. Questions that I will probe are whether the knowledge that is being used is scholarly or professional knowledge or everyday knowledge (i.e. the strength of the epistemic relation). Is the knowledge of waste, as produced and then used in the WoW programmes, specialised by its epistemic relation to the field of production, or its social relation to the knower; is it both epistemic and social; or neither epistemic or social? There is as yet no research in South Africa that addresses these questions.

To better interpret how knowledge *circulates* in workplace learning, I draw on the concept of *semantics* from LCT. Howard and Maton (2011) used LCT for the study of accumulation of knowledge and education. Maton (2009) has also used it to explore the role of knowledge

structures in knowledge building and how knowledge accumulates. In researching knowledge building and accumulation over time they used semantics which is one of the dimensions of LCT. As noted in Chapter 1, I have an interest in the accumulation and application of knowledge in the WoW programmes, since I noticed that even though training is offered, it does not seem to have a lasting impact. Maton (2013) referred to the importance of building on previous understanding and transferring it into future contexts in what he referred to as a process of cumulative knowledge building. In this study I have drawn on Maton's concept of *semantics* to explore how knowledge is built, accumulates and circulates in the waste management training activities and workplaces in EPWP projects.

As noted above, *semantics* is one of the dimensions of Legitimate Code Theory (LCT). It constructs social fields of practice as semantic structures where organising principles are conceptualised as semantic codes. Maton developed semantics because specialisation failed to fully grasp the issue of context dependence and condensation of meaning. Semantic codes are composed of strengths of semantic gravity and semantic density.

Semantic gravity refers to the degree to which meaning relates to the context. The degree by which the meaning relates to the context may be strong (+) or weak (-). The stronger the semantic gravity, the more meaning is attached to the context and the weaker the semantic gravity, the less dependent the meaning is on the context, for example a specific plant in biology has a stronger gravity than a species of a plant (Maton, 2009, 2011, 2013). In waste management, specific recyclables (paper, glass, plastic and foodstuffs) have stronger gravity than the categories of waste, for example solid waste, domestic waste etc.

Semantic density refers to the degree of condensation of meaning within socio-cultural practices whether they comprise symbols, terms, concepts, phrases, expressions, gestures or fashions. Semantic density may also be stronger (+) or weaker (-). The stronger the semantic density, the more meanings are condensed within practices. The weaker the semantic density, the less meanings are condensed. The nature of these meanings may comprise of formal definitions, empirical descriptions, norms, feelings and values (Maton, 2009, 2011, 2013). In classroom practice or training processes, meanings may be strengthened or weakened through the use of semantic density strategies (for example, a trainer may use concepts such as re-use or the symbol of re-cycling in waste management training) to convey meaning. Semantic profiles (see Figure 2.2 below) can be developed from observations and analyses of classroom

interactions to give an indication of how meaning making is being mediated. This also provides insight into how the knowledge is recontextualised via the actual training process.

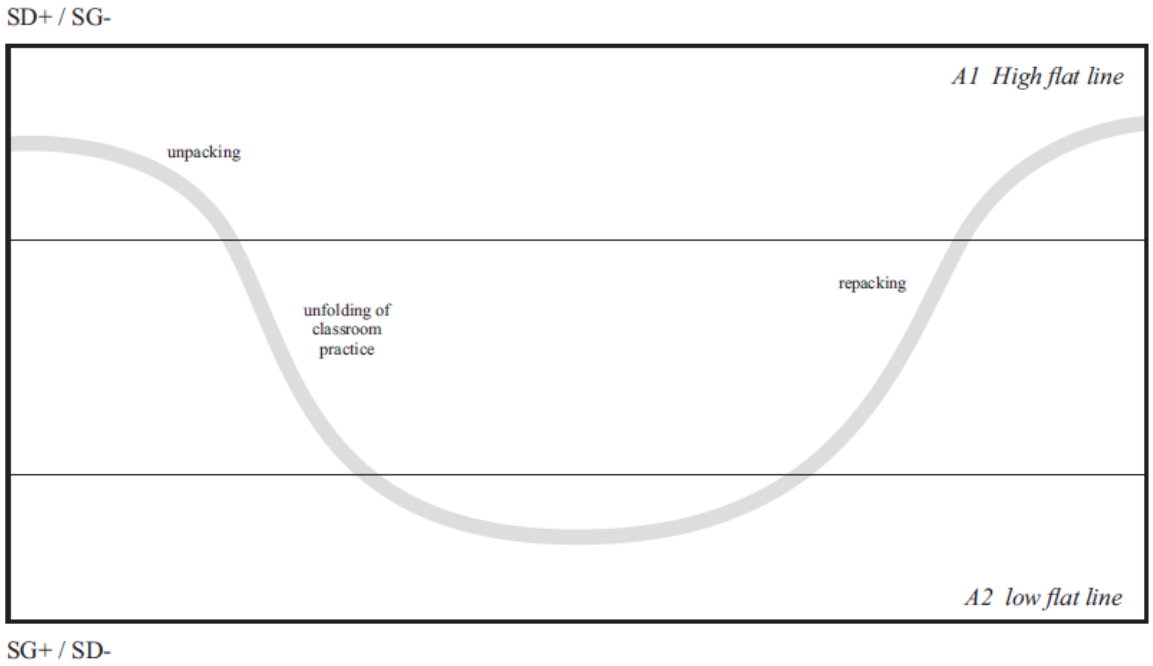


Figure 2.2: Drawing of a profile

The low flat line is called A2 and it shows the level of stronger semantic gravity (SG+) where more meaning is dependent on its context and the level of weaker semantic density (SD-) where less meaning is condensed to concepts or terms.

The high flat line is called A1 and it shows the level of weaker semantic gravity (SG-) where there is less meaning dependent on its context (decontextualised) and the level of stronger density (SD+) where more meaning is condensed within practices, for example concepts and terms. The semantic wave is labelled as B and shows the unfolding of a classroom practice and the flow, which is how concepts are unpacked and repacked. The above processes are utilised to analyse the observations of training classroom practises in the EPWP waste training activities. From the analyses, semantic profiles relevant to this study will be highlighted and drawn.

How strengths of semantic gravity are determined and realised depends on the specific object of study; for example, Martin (2013) undertook a study in biology. He realised that in biology the name of a specific plant in biology embodies a stronger semantic gravity than processes such as photosynthesis. Secondly, knowledge building requires both upward shifts from

specific contexts and meanings and downward shifts from generalised and highly condensed meanings. In waste management also I think an example of waste, for example paper, has a stronger semantic gravity than a category of waste, for example general waste. One can use these to discuss the changes in knowledge over time in a pedagogic activity. This can also be used to describe processes of weakening (SG) and strengthening (SG) of a semantic gravity. Weakening of semantic gravity is the movement from concrete to generalisations or the abstract. Strengthening of semantic gravity entails the movement from abstract or generalisations to the concrete (Maton, 2013, pp. 9-11).

As argued for in the section above, a social realist approach to knowledge is utilised to guide this study because it does not depict knowledge as either/or, but as both/and. As outlined above, such a theory of knowledge can address different approaches to knowledge and the knowledge circulation process. It is also useful for studying the underlying principles of waste management knowledge at the level of production and the knowledge that workers may bring from their previous experiences (home, school), as well as the workplace and training knowledge practices in their totality.

2.5 CONCLUSION

This chapter discusses the conceptual and the theoretical frameworks which guide this study. The chapter provides an orientation to learning, workplace learning and its interpretation as they are the focus of the study as discussed at length in Chapter 1. The second section (sections 2.3.4 and 2.3.5) discussed the theoretical frameworks which guide the study and its interest in knowledge and knowers, and what and how knowledge circulates and is legitimated in the EPWP WoW training context. It discussed knowledge in some depth and presented a social realist argument and framework for studying knowledge. It traced the changes in the development of knowledge from Durkheim to Bernstein, ending with the developments and adaptation of it by Maton. The chapter presents the key dimensions of Maton's LCT and indicates which of the dimensions of this theoretical perspective would be used for this study, namely specialisation and semantics, as they provide ways of developing a more in-depth understanding of how knowledge is produced and is recontextualised, taking cognisance of both knowledge structure and knower structure. The next chapter presents the research methodology and methods.

Chapter 3:

Research Methodology and Design

3.1 INTRODUCTION

In Chapter 1, I introduced the research context and problem. In Chapter 2, I reviewed literature relevant to the problem being investigated and developed the theoretical framing of the study. In this chapter (Chapter 3), I discuss the methodology, research design, methods and modes of analysis employed in the research. The research design and analysis process was guided by the five research questions which are specified below:

1. What is the structure of legitimate knowledge and the knower in waste management?
2. What are the underlying principles underpinning knowledge and the knowers in waste management?
3. How is the knowledge recontextualised in the waste management training qualifications, documents and manuals for worker training on the NQF?
4. How is the knowledge reproduced and evaluated in the waste management Expanded Public Works training activities (formal) and workplaces (informal)?
5. How does waste management knowledge circulate amongst the workers in the training activities and workplaces? (see also section 1.3.2)

The first question investigates the structure, the nature, the development and what is considered legitimate knowledge and the knower within the field of waste management at the level of production. The second question explores the underlying principles underpinning that knowledge and knower at the level of production using Maton's legitimate code theory. The third question investigates how the waste management knowledge is recontextualised, framed and sequenced in qualifications, programmes and providers' materials at Level 2 of the National Qualifications Framework. Questions 4 and 5 investigate the reproduction and circulation of knowledge in both formal and informal settings within the EPWP projects. The formal settings are inclusive of training activities planned and implemented in the project while the informal settings include the whole process of engagement in the project activities.

As can be seen from the above, the study object was complex and the research process therefore needed to be guided by an appropriate study design. A qualitative case study design, unfolded in phases, was selected as this allowed for dealing with the complex research objects.

3.2 QUALITATIVE, SOCIAL REALIST CASE STUDY RESEARCH

This research aims at probing the nature and the structure of knowledge in waste management as explained in the first paragraph. The study had an exploratory purpose, particularly to examine legitimate knowledge and the knower and its underlying principles at the level of production, recontextualisation of this knowledge as found in documents and training materials and circulation of the knowledge during reproduction *in situ*. This exploratory purpose consequently made the qualitative paradigm the most appropriate choice for the investigation (Cohen, Manion & Morrison, 2002). A complex enquiry of this kind requires an in-depth analysis of waste management knowledge at three levels of the pedagogic device and it also requires a design that allows for in-depth detailed analysis of cases. In consequence, therefore, qualitative research techniques using an inductive and abductive mode of inference and analysis of case studies were used. As reported in Chapter 2, the study drew on social realism underlaboured by critical realism and the case study can therefore be described as a social realist case study that drew on descriptive and narrative types of data. The goal of qualitative research is to understand situations from the contexts and research participants' perspectives, and to provide detailed, descriptive insights into a phenomenon.

While the study is a social realist account of knowledge production and circulation, in the unfolding of this account study, I relied on inductive, interpretive research strategies (where I seek out patterns in the data), as well as abductive, interpretive research strategies (where I recontextualise data using theory). The study cannot therefore be classified as a study in the inductive, interpretive tradition only, as I also used theory to recontextualise and describe data (especially the social realist theory of Maton and Bernstein, as explained in Chapter 2). However, many of the features of interpretive research are relevant to this study. According to Janse van Rensburg (2001), researchers using these strategies are interested in the meanings that people make of phenomena. Terre Blanche and Kelly (1999, p. 123) stated that researchers working in the interpretive tradition assume that people's subjective experiences are real and should be taken seriously. This is a perspective that I agree with at the level of the actual and empirical in Bhaskar's 2008 critical realist framework, but not at the level of the real, as Bhaskar noted that to conflate subjective experiences with the real, is to create the epistemic fallacy, which involves "analysis of being in terms of our knowledge of being", i.e. that which is said is taken to be the same as that which exists. Bhaskar however, noted that the actual and the empirical are also real, but he proposed a differentiated ontology to avoid the epistemic

fallacy, as well as ontological monovalence (which according to Bhaskar (2008, p. 400) is a "purely positive account of reality"). To deal with this, Bhaskar proposed differentiating between the transitive and intransitive to differentiate epistemology from ontology. Transitive reality involves the senses, sense making and experience of social processes. Intransitive reality involves objects or phenomena that exist or act independently of our meanings or views of these.

Thus, in analysing knowledge circulation using interpretive lenses, I refer mainly to the analysis work in the transitive realm. This allowed me to give attention to understanding others' experiences by interacting with them and listening to what they tell us (epistemology) and the qualitative research techniques that are best suited to this task (methodology). As noted above, while using interpretive methods, this study is guided by social realism which is underlaboured by critical realism (Bhaskar, 1998). Like interpretivists, critical and social realists also understand the empirical experiences of people to be real (ontology level 1) but also understand the events that shape these experiences (ontology level 2) and those underlying mechanisms that shape these experiences (e.g. the knowledge and knower structures as said by Maton) (ontology level 3) to be real. Maton (2014)'s knowledge and knower structures therefore provided a means of analysis at the level of the intransitive realm.

The study therefore took account of critical and social realist ontology which assumes that there is an intransitive world out there independent of observations and thus that our knowledge of the world is fallible and theory laden. It also took account of critical realist epistemology, which allows for the construction of multiple perspectives on the world. This was explored via interpretation of first-hand accounts. As suggested above, critical realism /social realism can underlabour interpretivist research or epistemological analysis, by providing deeper insights into the 'structuring structures' that shape the first-hand accounts, which is what this study sought to do. It focuses not only on what worker's first-hand accounts or experiences of waste management knowledge acquisition are, but also how this knowledge is structured, and how it comes to structure their experience via knower structures and the recontextualisation process (i.e. via pedagogical power relations and processes).

This study adopted the characteristics of qualitative research which were utilised by Chen (2010) in his study. These characteristics include a commitment to:

- ***Naturalistic settings*** by studying people, namely the workers in their actual settings as the study aimed to explore the particular contexts and their impact on the participants' views and knowledge (Maxwell, 2005). The participants' perspectives, views and actions show how they emphasise *meaning* (Creswell, 2007). This study presented the multiple meanings of individual actors attached to their experiences, but also investigated the processes that formed these meanings (Maxwell, 2005).
- ***Emergent design:*** The research design was responsive and adaptive (Merriam, 1998; 2002). This openness and flexibility is exhibited throughout the research process, from the shaping of research foci, and the selection of the participants and context, to collection and analysis of the data (Stake, 2005).
- ***Multiple sources:*** Gathering data from more than one source allowed me, as researcher, to examine the topic of interest in depth and to triangulate interpretations.
- ***Researcher as key instrument:*** As researcher, I gathered, translated and transcribed the interviews, questionnaires, and documented data myself. This process enabled me to develop deep insights for analysis (Bogdan & Biklen, 2003), as well as to make adjustments to the research design.
- ***Richness of data and description:*** The findings of the study were delivered through rich descriptions of the context, actors or cases and events (Merriam, 1998). This account was intended to reflect the complexity of the phenomena in question.

To capture the detail necessary of the complex phenomenon under investigation, I used the case study method, focusing only on one field or focus area (solid waste management), one programme (Expanded Public Works Programme) and two cases (two similar types of projects within EPWP) though they are situated in different areas. All the cases were related and to some extent were embedded or nested, i.e. the projects were embedded in the wider Working on Waste EPWP programme, which was embedded in the criteria and principles of this programme which includes solid waste management practice and knowledge sharing via training. Thus, the study overall can be described as a nested case study design (Lotz-Sisitka & Raven, 2004). Raven (2002) employed the notion of 'embedded' case studies in her research as a way of explaining how the nested cases in her study (course participants who were part of two tutorial groups that were located in a course) were all embedded in the wider context in which the course played out. In much the same way, the cases that I focus on are related in a 'nested' sense, but are also embedded in the wider context of Expanded Public Works Programmes especially as these are set up in South Africa.

Roberts (1996) and Cohen and Manion and Morrison (2004) defined case study as a method of studying a social phenomenon through analysis of individual or bounded cases of a phenomenon. The case may be a person, a group, an episode, a process, a community or any unit of a social life whose characteristics are observed over time. Easton (2010) claimed that case studies are more suited to respond to how and why questions which are explanatory in nature. They allow the opportunity to tease out and disentangle sets of factors and relationships which implies a continuous moving back and forth between the diverse stages. Case studies are particularistic, descriptive and heuristic (Easton, 2010, p. 119). They are particularistic in the sense that they focus in a special event or programme, descriptive because they look at many variables and analysis of their interaction overtime and heuristic as they enhance the readers' understanding of a phenomenon. Roberts (1996), Yin (1984) and Bromley (1986) stated that case studies do not have their own particular techniques of investigation. They draw on a whole range of research techniques used in educational research for example observations, interviews, document analysis and others. Terre Blanche and Kelly (1999, p. 256) noted that case studies have the benefit of providing in-depth insight into one particular situation, but they also have limitations which include potential problems with the validity of the information (hence triangulation of sources is needed), causal links are difficult to test, and generalisations cannot be made from single cases. They do say, however, that case studies are useful for generating hypotheses and methodologies that can lead to further research.

Sayer (2000) stated that it is possible to generalise at the level of the structures or mechanisms in critical realist case study research. As explained further by Danermark et al. (2001) there are two types of generalisation: "Empirical generalisations are expressed by means of empirical categories" (p. 78), whereas the type of generalisation in critical realism is expressed as a transfactual condition or fundamental structure. "Something can be general in two different senses – either in the sense of a *generally* occurring phenomenon / event, or in the sense of *fundamental / constituent* properties and structures" (p. 77). It is the latter sense of generality that I drew on in this study. I was therefore able to generalise from the 'structuring structures' of knowledge and knower to other waste management workplace training contexts, taking advantage of the critical realist generalisation scheme from the level of the mechanism.

3.3 BRIEF DESCRIPTION OF THE CONTOURS OF THE CASE STUDY

As indicated above, for this study I used the case study method, focusing only on one field or DEA EPWP focus area (waste management) and one programme (EPWP Working on Waste) and looking at two cases (two similar types of projects) within the EPWP Working on Waste programme, though they are situated in different areas. Related to the nested case study design, the study was also an integrated system as two cases (projects) of the *Working on Waste* focus area of the EPWP were explored to examine the learning taking place in the workplaces in some depth. The first project is situated in the Amathole District Municipality while the second one is in the Chris Hani District Municipality. They are both situated in the rural towns of the former Transkei region in the Eastern Cape. This area has been on the forefront in accessing funding for these projects due to the level of poverty surrounding these towns and the inability of the local government sphere to deliver on its mandate in the region. Though these projects are in the same province and region they are situated far apart and were managed by different service providers with different backgrounds.

The Waste Management Projects referred to above which were studied in the two District Municipalities, are classified under the *Working on Waste* focus area of the EPWP, which as mentioned in Chapter 1, constitutes one of the DEA EPWP Environmental Programme focus areas. The strategic objectives of this focus area are to create and support mechanisms for the protection of environmental quality, to create sustainable livelihoods through the recycling of waste, to support the use of environmentally friendly waste disposal technologies, and to promote waste management education and awareness in communities. The projects are guided by the Constitution of the Republic of South Africa, the Waste Management Act of 2008 and the Waste Management Strategy of 2011 (South Africa. 2013 EPIP Framework). *Working on Waste* is one of the initiatives of DEA, which seeks to ensure that both social and ecological sustainability are achieved through implementation of sustainable waste management practices.

The projects under this focus area are divided into categories. These categories entail both infrastructure and non-infrastructure projects. This research focuses on the non-infrastructure projects which include street cleaning and beautification projects, domestic waste collection projects and cleanest municipalities competitions. They are categorised as softer projects and therefore employ a number of workers. They are composed of the following deliverables: street cleaning by litter pick-ups and sweeping; beautification by landscaping and street sculpting;

conversion of dumping sites into mini-recreational areas; refuse collection in households not serviced by municipalities; capacity building, education and awareness for the public. As these projects are situated in the municipalities of rural towns, most of the waste dealt with in this area is solid waste. It is generally regarded that solid waste management is the sole duty and responsibility of local authorities and even in terms of the Constitution (Act 108 of 1996), municipalities are responsible for refuse removal, refuse dumps and solid waste disposal (Part B, Schedule 5). This is the group of projects which is utilised as the focus of this research.

The workers that are referred to in this study are workers within the Expanded Public works programme (EPWP) in South Africa who work within the above mentioned non-infrastructure *Working on Waste* Projects in the two Municipal Districts. As relayed in Chapter 1, the South African Expanded Public Works Programme was recommended as a short to medium term state-led strategy to address or more accurately alleviate poverty, creating opportunities for infrastructure and other forms of labour intensive development, while also improving skills, so that the unskilled workforce are more equipped to take up skilled work opportunities and benefit from the increasing demand for skilled labour (ANC, 1994, p. 16; Kraak & Press, 2008, p. 556). It supports workers to gain skills while they work and increase their capacity to earn income. Work is therefore matched with training/ skills development. This study therefore also focusses on those workers who are also engaged in the Working on Waste Training programmes.

From 2003 to 2012 the programme was at a chief directorate level. In 2012 the social responsibility programme in DEA was merged with the Working for Water programme from the Department of Water Affairs. It was elevated to the level of a branch. It is now headed by a Deputy Director General and called the Environment Programme's branch. The name of the Chief Directorate was changed from Social Responsibility Programme to Environmental Protection and Infrastructure Projects (EPIP) which is still a Chief Directorate within the branch. The case study is therefore located within this governance structure, which is also where I work.

As briefly mentioned in Chapter 1, I work as a Training Manager in the Environmental Programmes branch of the Department of Environmental Affairs (DEA), where the EPWP of the DEA is coordinated at national level. I have, over the years, been involved in various levels and forms of skills development in the National Qualifications Framework (NQF) context, ranging from teaching, to co-ordinating and contributing to qualifications and unit standards

development, to national management and monitoring of environmental training. I was an educator and a lecturer for twenty-three years before joining the Department of Environmental Affairs in 1998 (then called the Department of Environmental Affairs and Tourism). I was involved in the early development of environmental qualifications in the NQF and have been involved in supporting capacity building, and education and awareness programmes since then. Currently my role is to manage the delivery of training of workers in the Department's funded EPWP projects. I do this by working with training providers and project managers in the project sites, such as the two sites that are part of this case study.

The EPIP projects in the provinces are implemented by companies which act as implementing agents of the department. They include both private companies and government entities. The private companies are appointed according to the department procurement procedures stipulated in the EPIP guideline document (South Africa. DEA, 2013) based on the Public Finance Management Act (PFMA) regulations. In the provinces, the implementing agents for both project implementation and training are managed by provincial project and training managers who manage the programmes in the provinces. They report to the Directors in the Chief Directorate. This explanation provides insight into the relationship between myself, as national government official involved in this system of operation, also I in the study, and the research participants (see below for a more expansive discussion on my role in the research). As case study researcher, I collected data from workers and project implementers in the two projects sites where I was recognised to be in a senior management role. Both provincial project and training managers, project implementing agents, and the workers themselves, were aware of my role in the national department. This was therefore an issue which I needed to take into cognisance during collection of data and I had to engage in detailed discussions and explanations of the research with those involved, so that they understood the purpose of the research, and how this differed from my daily role and function as Departmental official. This was important to try to reduce the influence of my official role on the process of the research and I had to consciously separate the two and organise field visits accordingly. I had to request permission from all the officials to do research in their projects. I had to explain to them each time that the activities I was engaged in were for research purposes and would not interfere with the activities of the project. I reported to the officials concerned whenever I was about to visit the project, and also shared data back with them in discussions.

Another dimension of this case study is the waste management knowledge that I was focussing on. The National Environmental Management: Waste Act (South Africa. DEA. 2008) defines 'waste' to mean "any substance, whether or not that substance can be reduced, re-used, recycled and recovered, that is in surplus, unwanted, rejected, discarded, abandoned or disposed of, which the generator has no further use of, for the purposes of production". That waste must be treated or disposed. Traditionally waste management has mainly referred to collection and transport of waste to the landfill site but now South Africa is complying with international standards, as discussed in the previous chapters, and it is therefore paying attention to the 'waste hierarchy' which entails "… avoidance, prevention, minimization, reduction, recycling, reprocessing, reuse, recovery, composting, treatment and disposal of waste as the last resort" (Godfrey, 2008, p.1662).

In the academic sphere, in higher education, waste management has appeared mainly as 'modules' within various Public Health, Engineering and Natural Resources and Environmental Management Programmes, and in some instances as topics or research area within these study fields or Environmental Sciences where specialisms in Waste Management (mainly at the postgraduate level) are available for study. The most recent South African Classification of Educational Subject Matter (CESM) manual (South Africa. DoE, 2008), which is based on the *Classification of Instructional Programmes: 2000 Edition* released by the National Centre for Education Statistics captures waste management as an inter-disciplinary topic in a range of different Educational Subject Matter categories as follows:

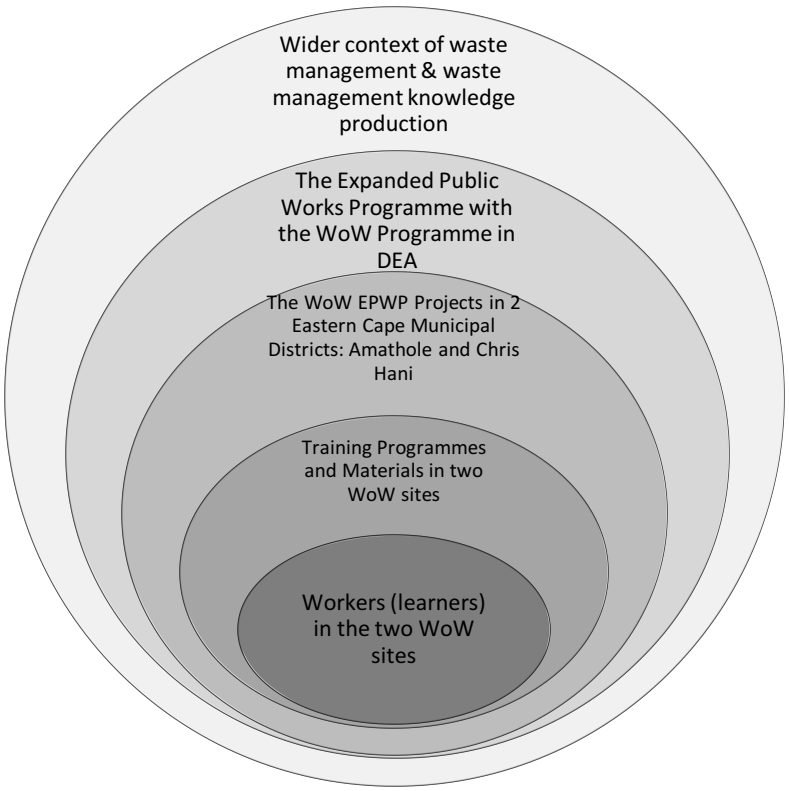
- As a topic in Natural Resource Economics and Environmental Management;
- As a topic in Geotechnical Engineering, and Water and Environmental Health Engineering;
- As a topic in Public Health under 'Environmental Health';
- As a topic in Environmental Law; and
- As a topic in Pharmacology and Toxicology.

This shows the interdisciplinary nature of waste management knowledge and therefore also its complexity. Even Environmental Management does not have its own CESM category, and it is classified with Natural Resource Economics. This shows that waste management is a relatively new topic that is being integrated into other CESM categories in the South African Higher Education landscape (South Africa. DoE, 2008). It has been identified as a component within these study fields because of waste's impact on the environment and because waste

management concerns often require an interdisciplinary response. According to Louis (2004), waste management practice has been running since the time of the move from nomadic to non-nomadic beings but it is only recently, since more attention has been paid to the negative effects of waste on health and the environment, that it has been more formally integrated into formal education curricula, an issue which has been also clarified and discussed in the South African Environmental Sector Skills Plan (South Africa. DEA, 2010) which commented on the 'newness' of much environmental knowledge, and hence its slow integration into established fields of education and training.

Since this is quite a new field of study academically, the case study commences by investigating the structure of solid waste management knowledge and its underpinning structuring principles at the level of knowledge production. This was necessary to inform the investigation of the structure and development of knowledge in waste management at the levels of recontextualisation and reproduction as little is known about the knowledge that is included at this level. To do this, I had to define the parameters of the knowledge that I was to examine, and the above definitions (South Africa, 1998; Godfrey, 2008), policy trends (see section 2.4.3.2) and representation in the CESM system (South Africa. DoE, 2008) helped to define the boundaries of the knowledge to be included in the case. According to Bernstein (1996), the level of production is where knowledge is constructed and it is situated in universities (but not exclusively so), as private and public research institutions also produce knowledge. This provides the rationale for the collection and analysis of research documents and government policies to inform the study on waste management knowledge at the level of production in this case study.

In sum, the contours of the case study are illustrated in the Figure 3.1 below, which shows the 'nested' nature of the case study.



Field of Production: Research Papers, questionnaires and policy documents

Field of Recontextualisation: guidelines, qualifications and training programmes used in the WoW EPWP programme in the two sites, including interviews and observations of training

Field of Reproduction: observations of workplace training programmes and workplace learning, interviews and focus groups with workers

Figure 3.1: The contours of the nested case study design, showing how these align also with the Field of Production, the Field of Recontextualisation and the Field of Production (Bernstein's Pedagogic Device)

3.4 DATA GENERATION

3.4.1 A Three-Phased Process of Data Generation and Analysis

The generation of data in this project was undertaken in phases using different tools. In the *first phase*, document analysis was utilised to explore what I and specialists in the field of waste management consider as legitimate knowledge or knowers with related underlying structuring principles. A range of documents inclusive of research papers and waste management policies and strategies were collected. For triangulation purposes, I also consulted waste management specialists, including officials of the Department of Environmental Affairs to investigate the nature of legitimate knowledge within waste management. Data was generated from departmental officials who are also specialists in waste management questionnaires. Research paper analysis was also complemented by the analysis of the leading waste management regulations in the country, namely the National Environmental Management Waste Act of 2008

and the Waste Management Strategy of 2011 as these represent what is seen to be legitimate waste management knowledge from a policy perspective.

In the *second phase,* the participants in the two projects were interviewed about three weeks after the commencement of the project. The purpose was to explore what they considered as waste in their homes and previous schools attended in comparison with what they considered as waste in the project. The interviews were unstructured. The purpose was to enable me to develop follow-up questions. The interview schedule was divided into four sections. The findings helped to determine what the workers perceived as legitimate knowledge at that level by looking at what they considered as waste and how they managed it both at home and in their previous schools. This provided me with an opportunity to realise the different dispositions and habitus the workers bring to the project. The relationship between the knowledge they bring and the perspectives identified at the level of production were then explored. After seven months of participation in the project, the workers in the two sites were interviewed for the second time. The purpose of the second interviews was to make meaning of their progress, to explore whether there was any change in their understanding of waste management processes and to make sense of the legitimate knowledge they gained by participating in the EPWP waste project.

The *third phase* explored how waste management knowledge was recontextualised into training documents and how that knowledge circulates during workplace training activities. One skills training programme offered by the programme in the waste projects which is situated at Level 2 of the national qualifications framework was selected for analysis. The unit standards and associated training materials used for training in the waste management workplaces at this level were collected from the SAQA website and were also analysed as these are key recontextualisation documents that are used to structure the training programmes. The fourth session of the training sessions for workers that relates to the Level 2 unit standard were observed and video-taped. This data provided insight into different knowledge and learning activities as found in the environmental EPWP waste management projects. Analysis explored the circulation of knowledge taking into consideration participation in the project (informal) and attendance of training interventions (formal). Further detail of these data generation and analysis processes is provided below.

3.4.2 Data Generation via Document Analysis in the Field of Production and in the Field of Recontextualisation

As noted above, document analysis in this study was utilised to deepen understanding of waste management knowledge as it is developing within the wider inter-disciplinary landscape noted above. The advantage of document analysis is that the documents are normally constructed prior to the enquiry and are therefore non-reactive and provide a useful source of historical data. Document analysis was used to probe the nature and chronological development of waste management as an inter-disciplinary study field, its valid knowledge, its conceptual development and knowledge and knower structures.

To scrutinise the structure of waste management knowledge as produced in the field of production, research reports and policies released into the public domain by producers of waste management knowledge were scoped and I identified research reports dealing with solid waste via a systematic online search of papers produced between 2000 and 2014 that covered all of the criteria below. The basis of the choice of papers was informed by these criteria:

1) the type of activities or deliverables emphasised in the DEA funded projects;
2) the framing of the concept of Waste Management outlined above (using the waste hierarchy);
3) the underlying purpose of the projects;
4) the criteria associated with the waste management projects in the rural towns; and
5) similar contexts especially African waste management contexts and developing country contexts.

As the projects are situated in municipalities in rural towns most of the waste dealt with in these areas is solid waste as solid waste management is regarded as the sole duty and responsibility of local authorities. In terms of the Constitution (Act 108 of 1996), municipalities are responsible for refuse removal, refuse dumps and solid waste disposal (Part B, Schedule 5) which are the activities of the group of projects utilised as the focus of this research. Therefore, I confined my search for research reports and policies that focussed mainly on solid waste as found in municipalities. I identified 32 research papers that met the above criteria. However, of these only 18 of the published research papers emphasised ***solid waste management in municipalities and the waste hierarchy,*** which I used as a final criterion for paper selection. The documents that were analysed are listed in the following table with their authors, the place

of publication, the field in which the papers or documents were produced, and the institutions involved in the production or recontextualisation of the knowledge.

As can be seen from Table 3.1 below, I analysed documents in the field of production (the 18 papers and two key policy documents), as well as documents in the field of recontextualisation, namely the unit standards that frame the waste management education and training activities in the EPWP WoW programme at Level 2, as well as waste management training materials produced by providers of the training.

Table 3.1: Documents analysed in this study

Authors & full title and reference of the research document	**Disciplinary fields & institutions in which the document was produced**
Research documents in the field of production	
1. Godfrey, L. (2008) Facilitating the improved management of waste in South Africa through a national waste information system. *Waste Management* (28), 1660-1671	*Disciplinary Field:* Natural Resource Management *Institution:* Council for Scientific and Industrial Research (CSIR), South Africa.
2. Godfrey, L. (2011) The role of waste data in changing behaviour: the case of South African waste information system (SAWIS). Unpublished PhD thesis. University of KwaZulu-Natal.	*Disciplinary Field:* Natural Resource Management *Institution:* University of KwaZulu-Natal.
3. Zurbrugg, C. (2002). Urban solid waste management in low-income countries of Asia: How to cope with the garbage crisis. Presented for: Scientific Committee on Problems of the Environment (SCOPE) Urban Solid Waste Management Review Session, Durban, South Africa, 1-13.	*Disciplinary Field:* Environmental Science and Technology *Institution:* Swiss Institute for Environmental Science and Technology, Switzerland.
4. Marshall, R. E., & Farahbakhsh, K. (2013). Systems approaches to integrated solid waste management in developing countries. *Waste Management*, *33*(4), 988-1003.	*Disciplinary Field:* Environmental Science and Technology *Institution:* Swiss Institute for Environmental Science and Technology, Switzerland
5. Muzenda, E., Belaid, M., Mollagee, M., Motampane, N., & Ntuli, F. (2011). Reflecting on waste management strategies for South Africa. *Proceedings of the World Congress on Engineering and Computer Science 2011 Vol II.* WCECS 2011, October 19-21, 2011, San Francisco, USA.	*Disciplinary Field:* Engineering *Institution:* University of Johannesburg: Engineering Department
6. Mokgae, M. (2011). Key Areas in Waste Management: A South African Perspective, *Integrated Waste Management* (2). Edited by Mr Sunil Kumar.	*Disciplinary Field:* Engineering *Institution:* South African Nuclear Energy Corporation (NECSA), Pretoria, South Africa.

7. Theron, J., & Visser, M. (2010). Waste management and the workplace. *Law, Democracy & Development*, *14*(1). DOI: 10.4314/ldd.v14i1.10	*Disciplinary Field:* Law and Social Justice *Institution:* Labour and Enterprise Policy Research Group, Faculty of Law, University of Cape Town. The Legal Empowerment Agenda: Poverty, Labour and the Informal Economy in Africa
8. Kumar, V., & Pandit, R. K. (2013). Problems of Solid Waste Management in Indian Cities. *International Journal of Scientific and Research Publications*, *3*(3), 1-9.	*Disciplinary Field:* Planning *Institution:* Faculty of Architecture and Planning, University of Science and Technology, Murthal, Sonepat.
9. Thompson, I. A. (2010). Domestic waste management strategies in Accra, Ghana and other urban cities in tropical developing nations. *Cleveland: Case Western Reserve University*.	*Disciplinary Field:* Planning / Urban development / Public Health *Institution:* Public Health Department, Western Cape Reserve University, Cleveland, USA.
10. Guerrero, L. A., Maas, G., & Hogland, W. (2013). Solid waste management challenges for cities in developing countries. *Waste management*, *33*(1), 220-232.	*Disciplinary Field:* Natural Sciences *Institution:* School of Natural Sciences, Linnaeus University, 82 Kalmar, Sweden
11. Kasozi, A., & Von Blottnitz, H. (2010). Solid waste Management in Nairobi: A situation analysis. *Report for City Council of Nairobi, contract for UNEP*.	*Disciplinary Field:* Engineering *Institution:* Environmental and Process Systems Engineering group. University of Cape Town for the City of Nairobi. Contracted by the United Nations Environment Programme.
12. Al-Salem, S. M., Lettieri, P., & Baeyens, J. (2009). Recycling and recovery routes of plastic solid waste (PSW): A review. *Waste management*, 29(10): 2625-2643.	*Disciplinary Field:* Engineering *Institution:* Centre of Technology, Department of Chemical Engineering, School of process Engineering, University College of London, Torrington Place, United Kingdom.
14. Larney, M., & Van Aardt, A. M. (2010). Case study: Apparel industry waste management: a focus on recycling in South Africa. *Waste Management & Research*, *28*(1), 36-43.	*Disciplinary Field:* Consumer Sciences *Institution:* Consumer Sciences Department, Faculty of Science, North West University, Potchefstroom, South Africa.
15. Yano, J., Hirai, Y., Sakai, S.I., Tsubota, J. (2014). Greenhouse gas emissions from the treatment of household plastic containers and packaging: Replacement with biomass-based materials. *Waste Management and Research,* 32(4): 304-31.	*Disciplinary Field:* Climate Change Science and Technology Studies *Institution:* Environment Preservation Research Center, Kyoto University, Yoshida Honmachi, Sakyo-ku, Kyoto *Institution:* Material Technology and Bioprocess Team, Energy Technology Laboratories, Osaka Gas Co.
16. Carvalho, M., Rosa, P., Bufoni, A. L., & Oliveira, L. B. (2012). Putting solid household waste to sustainable use: a case study in the city of Rio de Janeiro, Brazil. *Waste Management & Research*, 30 (12): 1312-1319. 0734242X12462280.	*Disciplinary Field:* Energy Planning *Institution:* Energy Planning Programme; Federal University of Rio de Janeiro, Brazil

17. Filho, W. L., Kruopien, J., Stenmarck, Á. S., & Moora, H. (2015). Towards sustainable waste management in the Baltic Sea region countries: the contribution of universities. *Progress in Industrial Ecology, an International Journal*, *9*(1): 96-108.	*Disciplinary Field:* Environmental Sciences & Engineering *Institution:* Swedish Environment Research Institute, Stockholm University, Sweden *Institution:* Institute of Environmental Engineering, Stockholm, Sweden
18. Hansen J. A., & Newman, D. (2012). Where science meets practice: *Waste Management and Research*. 30(9): 1-2.	*Disciplinary Field:* Engineering *Institution:* Environmental Engineering. Aalborg University, Aalborg, Denmark. *Institution:* Italian Composting Association & Italian Bioplastics Association
Policies[2] included in analysis	
Republic of South Africa. 2008. National Environmental Waste Management Act. No 59 of 2008. Pretoria. Government Printers.	*Disciplinary Field:* Policy and Law *Institution:* Department of Environmental Affairs
Republic of South Africa. 2011. Waste Management Strategy. Pretoria. Government Printers.	*Disciplinary Field:* Policy and Law *Institution:* Department of Environmental Affairs
Recontextualisation documents	
South African Qualifications Authority: 2015: 1 Waste Management unit standards at Level 2: *Separate, handle, treat and transport Waste*: Reference number: 119555	*Disciplinary Field:* Education and Training Policy *Institution:* South African Qualifications Authority
Waste Management unit standard at Level 2: *Separate, handle, treat and transport Waste*: Reference number: 119555 in two different learning materials. Authors of the learning materials are kept confidential.	*Disciplinary Field:* Education and Training *Institution:* Accredited with the Local Government Sector Education and Training Authority. Confidential

As can be seen from the above, the papers, and the disciplinary fields and institutional bases for the papers confirms the interdisciplinary nature of waste management knowledge as found to be relevant to solid waste management in municipalities and the waste hierarchy. The waste management policies and strategies were sourced from the DEA website (www.environment.gov.za) which carries the official version of these policies. They were analysed to examine the knowledge and knower structures associated with waste management

[2] In Bernsteinian studies, policies can also be analysed as recontextualisation documents. Here, I include the Waste Management Policies in the field of production as the Government Departments, Department of Environmental Affairs and the Department of Science and Technology are responsible for producing much of the waste management knowledge through their support for waste management research to inform policy (see below). I analyse the *training policy* documents, notably the unit standards produced by the Department of Education as official recontextualising field documents.

as determined by government in South Africa and to identify the structure of legitimate knowledge and knowers as prescribed by government using the specialisation dimension in LCT. The details of this analysis are contained in Chapter 4. The recontextualisation documents were similarly analysed, with emphasis on specialisation as well as semantics, with details contained in Chapter 4.

3.4.3 Generation of Data using Questionnaires

The Department of Environmental Affairs through the Branch: Chemicals and Waste is responsible for the development of policies, regulations and strategies for waste management within South Africa which, when ready, are approved by Parliament and signed off by the President. It works closely with the research arm of the Department of Science and Technology (DST) and the Council for Science and Industrial Research (CSIR) which is a research institute influencing the innovations in the waste management field DST (South Africa. DST, 2011).

In Bernstein (2000)'s pedagogical device, government departments are most often classified as official recontextualisers, operating in the official recontextualisation field where knowledge is transformed and recontextualised. This sways scholars to consider all government departments at the level of recontextualisation of the pedagogical device, which is one of the comments that I received during the presentation of my research proposal in 2013. However, as noted in Footnote 1 above and in Chapter 2, the Department of Environmental Affairs and the Department of Science and Technology are responsible for generating waste management knowledge, which they need to inform policy. They invest in, and support waste management research, knowledge production and innovation internally through programmes, and also through various scientific and practice partnerships. They are therefore also producers of waste management knowledge. This differs from the South African Qualifications Authority and the Department of Higher Education and Training, who recontextualise waste management knowledge in the official recontextualisation field through educational standards and policy.

Due to the major role the two departments (DEA and DST) play in *the development of waste management knowledge and innovations*, I have classified their officials as specialists in the field of production. A questionnaire was developed and sent to twenty specialist DEA and DST officials. Out of the twenty questionnaires distributed only seven officials managed to return the questionnaires. This data from the DEA and DST officials was collected through

questionnaires to complement the information received from research documents for triangulation purposes.

The questionnaire was divided into three sections. The first section sought biographical information inclusive of the officials' qualifications, fields of study and information on how and why they got into the waste section of the department (see Appendix 1). In the second section the officials were requested to explain how they got into the field of waste management and to give examples of types and content knowledge critical to be included in the training interventions of people at Level 2 of the National Qualifications framework who are working within the spheres of waste cleaning and litter pick-ups in municipalities. In the third section a Likert scale questionnaire was adapted from the study which was conducted by Lucila Fernandes De Carvalho (2010) at the University of Sydney in Australia. The specialists were given 11 practices and activities from which they were required to identify which opinions were important being good at waste management. The practices were comprised of propositional and procedural knowledge, skills and social aspects. These inputs were designed to assist me to understand what the waste management officials determine as the basis of achievement/ legitimacy and the underlying principles of waste management and whether the legitimacy of waste management is based on the knowledge code, knower code, dispositions or values.

The questionnaires accompanied by the letter of request were sent to the officials in the branch by email as I, as researcher, and the branch work within the same department and building. From the first group of questionnaires dispatched only one official responded. I then sent more questionnaires and reminders. As noted above, I received only seven questionnaires out of twenty questionnaires distributed. I transcribed all the questionnaires to begin the process of becoming familiar with the material. I also thought it would be easier to produce an accurate transcription since I was knowledgeable about the topics discussed. These are listed in the appendices as Appendix 2. The biographical data of the participants are given below. The names given are pseudonyms.

Table 3.2: Biographical data of the Department of Environmental Affairs participants

Name	Gender	Experience in Waste Management - years	Qualifications	Highest qualifications	How they got into the Waste Management (WM) field

Desmond	Male	8	Diploma in environmental Engineering (2)	MBA	My interest in applying chemistry in WM particularly hazardous waste influenced me
Eric	Male	11	Bachelor in Environmental Sciences (1)	Bachelor's degree	Love clean and healthy environment and opportunities in the field of WM
Khalo	Female	7.5	Master's degree in Environmental Management	Masters in Environmental Management	My studies in EM and WM is one of the key careers within EM
Shalo	Female	14	Environmental Engineering	MSc	Applied for vacancy in waste management section
Tshilo	Female	15	Masters in Environmental Management	Masters in Environmental Management	No answer
Tembi	Female	10	I have it as part of other qualifications and have attended short courses	Masters in Environment and Society	Started with an assignment on an environmental education course. Then I got interested and learnt more.
Sister A	Female	12	Did waste Management as a course as part of my Honours degree	MSc. Environmental Science	I did some work on a part-time basis while studying towards my Master's degree for a consulting firm which specialises in waste and they offered me a permanent job after completion of my studies.

The group of participants can be summarised as follows:

- Two are males and five are females,
- They are all graduates from the Natural Sciences or Engineering, with specialism in Environmental Management and/or Waste Management; one has specialised in Business Administration and the other in Environment and Society.
- They have done waste management as a module in one of their courses,
- They have Masters degrees with the exception of one.

3.4.4 Data Generation through Workers' Interviews

I requested and was granted permission from the Chief Director: Environment Protection and Infrastructure Programme (EPIP) to conduct the research with the workers of the EPIP

programme. I interviewed workers who had recently joined the project in order to establish what the workers knew about waste management prior to joining the project. This relates to Bourdieu's explanation of habitus and the dispositions. Bourdieu as cited by McNamara (2010) said that dispositions are acquired from a young age through participants' interactions with each other and the interactions within the contexts around them. Maton (2008, p. 56) said that the habitus is more than a habit; it is focused on generative principles that bring about different choices and actions of agents. Agents' habitus exists because of practices of agents, their interactions with each other and the rest of the environment and are therefore not static but dynamic. Habitus is shaped by the environment in which it is nurtured and is therefore unpredictable, even random and arbitrary. I was interested to enquire whether the workers' knowledge and actions in the projects were influenced by their previous activities and actions or not. Bernstein (2000) and Maton and Moore (2010) concurred "… knowledge like the habitus is a structured structuring structure. It is structured because it is the result of past conditioning and experiences and structuring because it plays a role in shaping the current practices" (Maton, 2014, p. 6).

Further permission to undertake this research was requested from the implementing agents concerned and their Project Managers to conduct the research in the context of the projects. This study commenced in 2013 but this part of the collection of data was delayed from 2013 to 2014 as most of the projects were towards the end of their term of operation when I started the research and new projects were still in the planning phase. As depicted in section 3.4.1, the interviews were conducted in October 2014 three weeks after the start date of the project. Projects that were ready for operation, were indicated by the project manager who further negotiated access to workers with the implementer. I also negotiated individual permissions with each worker as outlined below.

As noted above in section 3.4.1, the interviews were conducted in two projects in the Eastern Cape because they were the first to recruit workers and were ready for implementation in the new phase of operation which started after the commencement of this research. My mother tongue is isiXhosa which is spoken mostly in the Eastern Cape. Most of the workers dropped out of school many years ago; they struggle with English as second language and interactions of any form with them in English require one to engage in a lot of interpretation (code switching). I did not have this problem as I communicated with workers directly in isiXhosa. Interviews were divided into two phases.

- ***Interviews – Phase 1***

These interviews were conducted in October 2014 three weeks after the commencement of the project. I visited the projects as a researcher and was welcomed. I requested permission to record the deliberations but indicated that the interviews were only for research purposes and would not disadvantage the activities of the project in any way. About six beneficiaries were selected from the project taking their level of education and gender issues into consideration, that is they included both males and females. I interviewed them individually. I introduced myself to each worker and indicated that I belonged to the same department as them using the logos on their branded uniforms. I requested permission to interview using the tape recorder, as I felt it would be difficult to lead the discussion and capture all the deliberations at the same time. All were willing to participate in the project.

In each project there were about forty participants which were divided into groups according to ages, gender and their portfolios within the project. To prevent a validity threat I requested the project managers to do the selections of participants for the interviews which should be inclusive of all the categories in the projects. Six workers were chosen by the project managers per project to participate in the interviews, and were also approached by me to make sure that they were willing to participate in the research as described above. Biographical data of the respondents is summarised in Tables 3.3 and 3.4 below and captures names (pseudonyms), gender, rural/urban location and heritage, level of education, last school attended, school zone (rural or urban), previous and present jobs.

Table 3.3: Biographical data of participants of Project 1 (names are pseudonyms)

Name	**Gender**	**Rural/urban**	**Level of education**	**Last school attended**	**School zone (R/U)**	**Previous job**	**Present job**
Cawekazi	Female	Rural	Grade 12	Zwelihle SSS	Rural	Cleaning in Ntsika-Yethu Municipality for 3 months	Litter picking and street cleaning
Luma	Male	Rural	Grade 12	Dinizulu SSS	Rural	None	Litter picking and street cleaning
Love	Male	Rural	Grade 12	Nqabisile SSS	Rural	Worked as a cleaner in Pelopepa Health Train	Litter picking and street cleaning

Happy	Male	Rural	Grade 12	Nqabisile SSS	Rural	Cleaned aeroplanes in Cape Town	Litter picking and street cleaning
Andisiwe	Female	Rural	Grade 8	Kholobhisi	Rural	Worked in the municipality for 3 months – cleaning waste	Litter picking and street cleaning
Sindi	Female	Rural	Grade 11	Dinizulu SSS	Rural	Worked in furniture shop	Litter picking and street cleaning

Project 1 belongs to the street cleaning and litter picking category according to the types of projects under the Working on Waste focus area. Table 3.3 above shows that I interviewed six workers from this site, three females and three males. They all grew up in rural areas near their current place of work. Most of the workers in the project are from the surrounding rural areas. Some of them travel every day from home to work using public transport. Those coming from a distance rent accommodation near their places of work. Four of the interviewee respondents from Project 1 had passed grade 12 while two dropped out of school. Four were doing cleaning work in their previous jobs. Two have been cleaners in the municipalities, which is similar to the work they are doing in the project. Three of them have cleaned trains, aeroplanes and shops. One of them has never worked because he had recently graduated from school.

Table 3.4: Biographical data of participants of Project 2 (names are pseudonyms)

Name	**Gender**	**Rural/urban**	**Level of education**	**Last school attended**	**School zone (R/U)**	**Previous job**	**Present job**
Abongi	Male	Rural	Grade 9	Ntabankulu High School	Urban	Cleaning, scrubbing and cooking (barbecue) meat in MAX in Durban	Litter picking and street cleaning
Khaya	Male	Rural	Tertiary institution /	Walter Sisulu: Butterworth	Urban	Intern Department of Education	Litter picking and street cleaning
Lizo	Male	Rural	Grade 8	Manzana – Mt Ayliff	Rural	Security	Litter picking and street cleaning
Mfana	Male	Rural	Grade 11	Mnceba	Rural	Building and motor mechanic in Mpumalanga	Litter picking and street cleaning

Sanda	Female	Rural	Grade 11	Sophumelela - Cape Town	Rural	Removing paint on old cars – three-week contract job	Litter picking and street cleaning
Bongi	Male	Rural	Course 1: Building Engineering	Border Technikon	Urban	Insurance agent	Litter picking and street cleaning

Project 2, like Project 1, belongs to the street cleaning and litter picking category according to the types of projects under the Working on Waste focus area. Project 2 has about sixty participants in the project. To prevent a validity threat the project managers were requested to do the selections of participants for the interviews which should be inclusive of all the categories in the projects. Six workers were chosen by the project managers per project to participate in the interviews project, and were also approached by me to make sure that they were willing to participate in the research as described above. I therefore interviewed six workers: one female and five males from this project. They are all from rural areas. Two of the participants have been to tertiary institutions in urban areas and had a schooling experience different from others who attended school in the rural areas. Their previous working experiences are different and not related to cleaning or the project they are in. Two of them were foremen within the project.

- ***Interviews – Phase 2***

These interviews were conducted seven months after the commencement of the project. I, for the second time, sent communication to the provincial managers, the project managers and the project implementers making them aware of the second visit to the project. In the first project the collection of data was conducted immediately after the Easter holidays and weather was bad (it was raining). The workers had reported to work but were indoors, accommodated in a municipal hall due to the weather conditions. The aim of these interviews was to make sense of what the workers had learned about waste management during the time of their participation in the project. The interviews were recorded. This interview had only one question. Each candidate was requested to share what he or she had learned and gained so far while participating in the project. Because of scanty responses I had to many follow-up questions. An example of a transcript is tabled in the appendices as Appendix 3.

As noted above, these were follow-up interviews. I had planned to interview the same participants that I interviewed in the phase one interviews. To my dismay only four of the six

interviewed participants were available in Project 1. It was reported that the other two had left the project. The two were substituted by the another two who were in the project since the time of its inception. I included them in the interview process, after carefully explaining the process to them. Initially I thought this might present a validity threat to the study, but upon reflection on the data generated I realised that the data provided provided valuable perspectives on workers' knowledge in the projects, and I therefore included the new participants data. In the second project all six participants were still available in the project, and were interviewed. The interview in the second project took place in August 2015 in the project offices.

3.4.5 Observations

Observation is a research technique that lies at the heart of case studies. An observation is defined as "a purposeful systematic and selective way of watching and listening to an interaction or phenomenon as it takes place" (Kumar, 1996, p. 106). One watches while things are happening. Mouton (2001) identified two types of observations in qualitative research: simple (non-participant) observation where the researcher remains an outside observer and participatory observation where the researcher is simultaneously involved in the activities being researched**.**

I had requested permission to utilise the learning materials for the training provider who was offering the training to the workers at the beginning of the year and was granted this permission. When the provider was contracted to conduct training in this project, I phoned the provider for a second time to renew the agreement. The provider furnished me with the name of the facilitator and the start date of the training. The activities of each day were observed and were audio and video-taped. I had to bring a second person to assist with managing the video-taping of the lessons. I requested and was granted permission to utilise the video from the facilitator on the first day.

I observed the characteristics of the pedagogical processes, interactions, and individuals' actions during training in the workplace. The aim of the observation was to gain further insight into the structures of knowledge and workplace learning and especially to observe how knowledge circulates in the workplace training via the different procedures and pedagogies as the lesson unfolds and how the individuals themselves learn and use knowledge in practice (Cohen, Manion & Morrison, 2004). I transferred the video data onto my computer and transcribed this. An example of a transcript is tabled in the appendices as Appendix 4.

3.5 ANALYSIS OF DATA

3.5.1 Analysis of Data in the Field of Production: Documents and Questionnaires

Analysis of research papers and developing the categories of analysis

To start the process of analysis, I read through the documents. Social realists argue that "knowledge is not only social; it is also real. It is termed social because all knowledge is socially produced by communities of knowledge producers and is real because it is about an objective world" (Howard & Maton, 2011, p. 194). Taking this into consideration, I commenced by identifying who the producers of the knowledge or specialists were in the field. I noted who the researchers were and their fields of specialisation and qualifications. I realised that some were not specialists in waste management and they were writing about waste management from different stances or positions and fields, as indicated in Table 3.1, which reflects the inter-disciplinarity of waste management knowledge production. The knowledge producers/authors of the papers were grouped and categorised according to the producers' fields of specialisation. The details listed are tabled in Chapter 4.

To frame the analysis, I drew on Maton (2007, p. 97), who said that the specialisation dimension of the LCT tool kit is based on the answers to the following question, "What makes actors, discourses, and practices special or legitimate in an intellectual field? Is it knowledge (knowledge code)? Is it learners' dispositions i.e. inherent qualities of mind and character (knower code)?" Based on this statement and the wider insights into specialisation as reflected in Table 3.1, I posed the following analytical questions, "What is declared legitimate or emphasised by the specialists/researchers in this field? What was contained in the research papers/documents?" I had to understand what knowledge was and what the knower was in this field.

From here I approached the analysis by identifying common content knowledge from the different papers, highlighting this using different colours, and matching these across documents in order to develop common reflections on the content knowledge. The content knowledge from the research papers was later put together into an analytical memo (Appendix 5) on waste and waste management. The content in the document was coded and further categorised into knowledge codes and/or knower codes associated with waste management. In order to understand knowledge in waste management I drew mainly on Bernstein's categories of knowledge, but I also found the earlier work of Gamble (2006) useful (she also drew on

Bernstein's theory), which clarified the types of knowledge in waste management as inclusive of propositional, procedural, theory and practice.

From this, I developed a framework for analysis which is inclusive of the categories outlined in Table 3.5 below:

Table 3.5: Categories of knowledge used for analysis (adapted from Bernstein 1990)

Type of knowledge	What it entails/ description	Indicators
Propositional knowledge/ context independent knowledge	Knowledge that exists only in abstract form. Arrived at through a process of logical deduction.	Definitions, names of things, concepts, deeper levels of concepts, deeper levels of conceptual knowledge, types of things, facts, and propositions
Procedural knowledge	Derived from concrete events or experiences that happened in a specific time and space	Skills, procedures, processes and techniques
Technical Knowledge	Pertain to an art or technical skills. Limited to instruction in the principles of science and art applicable to industry. Colleges provide theory part and the part of practice – done by industry- as industries did not want to expose their art	Knowledge inclusive of science and techniques (theory and practice)
Vocational / craft knowledge (Practical)	Acquired through apprenticeship i.e. one learning a skill through a skilled employee. Cannot be acquired other than by doing	Learning by doing from another skilled employee
Practical knowledge	Resulting from practice, action and depend on activities	Skilled in techniques rather than abstract thinking

Bernstein (2000) described this as an external language of description while Cohen (2010) identified it as a translation device. I built on this, and added other types of knowledge identified in my data to further develop the analytical tools (see Table 3.6 below).

Table 3.6: Bernsteinian knowledge categories inclusive of other types of knowledge identified by the researcher

Type of knowledge	What it entails	Indicators
Propositional knowledge/ context independent knowledge Theoretical/Abstract	What exists only in abstract form	Definitions. Names of things: Concepts, deeper levels of concepts Types of things: Facts, and propositions

Procedural / processes context-dependent knowledge	Derived from concrete events. Knowledge how	Experiences that happen in a specific time and space
Technical knowledge	Pertain to an art or technical skills. Includes theory and practice Limited to instruction in the principles of science and art applicable to industry	Includes theory and practice Instruction in the principles of science and art applicable to industry
Social knowledge Dispositions, values and attitudes	Dispositions values and attitudes	Includes values and attitudes developed through interactions in contexts and society
Vocational / craft knowledge	Can be acquired through apprenticeship	Learning a skill through a skilled employee
Practical knowledge	Resulting from practice and action	Learning a skill through practice and taking action
Historical knowledge	Make reference to how processes change within time and space	WM processes changing within the space of time / within space and space
Legislative knowledge	Shows reference to legislative frameworks	Information from legislative frameworks
Economic knowledge	Shows some reference to monetary issues and entrepreneurship	Monetary and business issues

From understanding of what knower aspects are in waste management, I had to determine the knower in waste management. As indicated by Maton (2010), the knower code is related to the social aspects of life. Chen (2010) indicated that the realisations of theoretical concepts are different when used for different objects of study; for example, in one study the way knowledge and knower are realised may be different to another study. An example of this can be found in the study of school music by Lamont and Maton (2008): the knower code is represented by one's aptitude, attitude and personal expression while knowledge is represented by knowledge listed in the above tables. In this study the social relation (relation to subjects) is depicted by the emphasis of waste management on social aspects and persons related experiences. The analysis to interpret the knower code (ER+) is summarised below in Table 3.7.

Table 3.7: How the knower is represented in waste management in this study with examples from documents (represented by people's experiences and social aspects)

Financial / Socio-economic	**Socio-cultural**	**Places of abode and inequalities/Infrastructure**
Landfilling is the cheapest and most convenient method of waste disposal	Before considering a recycling programme, it is necessary to consider the involvement of the general public	They comment that residents of core urban areas have good access to refuse removal services

Recovery of energy through incineration or biodegradation utilising the resources embedded in waste and contribute to saving raw materials	Waste management refers to collection, transport, processing recycling or disposal of waste materials produced by human activity	Those in peri-urban and rural areas have limited access to formal services Waste services not accounted for in rural towns. Staffing in these areas is skewed towards labourers
Generators from low income areas whose residents form 60% of the city's population – their characteristic is that they have a limited ability to pay for solid waste management services In developing countries there are scaring inequalities, varying economic, cultural, socio-economic and political land scapes, governance, policy, institutional and responsibility issues. International influences have created technical and non-technical challenges of immense complexity in developing countries (Konteh, 2009).	Prior to year 2000 developed countries never considered social aspects. They focused only on economic and environmental aspects (Morrisey & Browne, 2004) In developing countries there are scaring inequalities, varying economic, cultural, socio-economic and political landscapes, governance, policy, institutional and responsibility issues International influences have created technical and non-technical challenges of immense complexity in developing countries (Konteh, 2009)	Many cities in low income countries experience the problems that were experienced by the high income countries in the 19th century, for example, high levels of urbanization, degrading sanitary conditions, unprecedented levels of morbidity and mortality (Wilson, 2007) In developing countries there are frightening inequalities, varying economic, cultural, socio-economic and political landscapes, governance, policy, institutional and responsibility issues

The study of waste management knowledge at the level of production also indicated that waste management has a history, developing with time and being dynamic as suggested by Maton (2008, p. 56). The historical development of waste management is discussed in the next chapter (Chapter 4). Given the inter-disciplinary nature of waste management knowledge, I also realised that the content knowledge of waste management includes references to many other disciplines. I identified the other disciplines referred to, and contributing to the field in the documents (see also Table 3.1 above). This showed how content structuring the interdisciplinary field of waste management was emerging. A table showing the connections with other disciplines was developed (see Table 3.1 and Table 3.2). To reflect on this, I used Bernstein and Solomon's (1999) discussion of classification using his metaphor of boundaries.

To deepen the analysis, I had to ask how the epistemic relation to the object / knowledge code as well as the social relations to the subject/the knower code is represented in waste management content knowledge and related recontextualisation processes. Maton (2007), drawing on Bourdieu's work on fields in his epistemic advice, said that "every practice or knowledge claim is made by someone and is about something … fields should be understood as knowledge-knower structures … for every knowledge structure there is a knower structure"

(p. 87). He said that knowledge claims can be seen as specialised by their epistemic relation and their social relation and by both or neither. The knower code specialises in the personal characteristics of the author, actor or agent. It emphasises the dispositions of actors, aptitude, attitude, personal expressions ability to express themselves and creativity (see section 2.5.5.4). As I read through the data initially, I did not understand how to recognise these characteristics within waste management knowledge, education and training. I had to read other research and dissertations using the same tools to see how they were applying this theory to other empirical contexts. I drew insight from Arbee (2012, p. 84) who commented in his research that "the identification of a theoretical framework and concepts that are appropriate to a research area of interest are not sufficient by themselves to enable any analysis of data, this is because the same theoretical concept may manifest itself differently in different studies". Chen (2010) also indicated that "the realisations of these theoretical concepts (knowledge and knower concepts) are different when used for different objects of study due to the particularities and specificities of the context of enactment" (Chen, 2010, p.77).

In Doherty's (2008) study in cultural production, the concept of "knower code" was displayed as an emphasis on one being a member of a particular culture, or having experience with that culture, while in Lamont and Maton's (2008) study of music, the "knower code" is explained as an emphasis on one's aptitude, attitude and personal expression. Chen (2010) explained the knower code differently for the different facets of his study. In the part dealing with curriculum he explicated the knower code as "the learner's personal knowledge and experiences", in the part dealing with pedagogy he identified it as the "personal dimension of the learning process" and in assessment "as learner's self-evaluation" (Chen, 2010, p. 81). Thus, it was necessary for me to devise the meanings of the knower code in waste management for the different positions of study commencing with meaning at the level of production.

I commenced by listing terms associated with social relations by Maton in his framework and listed their dictionary meanings, as shown in Table 3.8 below.

Table 3.8: Dictionary meanings of words explaining the terms for the characteristics determining the knower code used by Maton

Characteristics	Attitudes	Attributes	Aspects	Sensibilities	Aptitude	Social
Their meanings	Approach	Qualities	Features	Deep feelings	Values	Communal
	Outlook	Characteristics	Facets	Emotional response	Principles	Community
	Manner	Features	Characteristics	Responsiveness	Standards	Common
	Stance	Points	Portions	Receptivity	Morals	Societal
	Position	Aspects	Parts	Susceptibly	Ethics	Public
	Feelings	elements	Pieces	Feelings	Ideals	Shared
	Thoughts		Phases	Awareness		Collective
	Mind-set		Sides			Group

I therefore matched the above dictionary meanings and terms with the content knowledge I put together and coded. I realised that these terms are inclusive of people's emotions, qualities, morals and behaviours within society as well as the issue of people's positions and mind-sets. From this, I established that the knower code in waste management is comprised of social aspects and people's experiences which consist of the above characteristics. I therefore developed a table of social aspects inclusive of and informed by attributes, attitudes, behaviours and sensibilities which surfaced from the data. I was able to develop an analytical perspective on the knower code, in which the social aspects in waste management are inclusive of the following actions:

- Changes in people's behaviours and actions;
- Changes in people's attitudes and ethics;
- Paying attention to social aspects influencing issues in society;
- Ability to solve social problems;
- Ability to assist other people to solve problems;
- Working towards improving personality traits and well-being;
- Ability to make decisions; and
- Ability to create awareness processes influencing people's lives.

From here, I was able to consider how to analyse the content in the research papers based on a relevant knower code for waste management. I was then able to consider how content demonstrating the above actions could be classified under the knower code. I developed a table based on the above (see Table 3.7) which depicts the social aspects of waste management knowledge (knowledge emphasising the author/ social relations to the subject) (SR+). This allowed me to analyse the knower code emanating from waste management knowledge.

I utilised two tables to do the analysis of the research papers, one consisting of knowledge emphasising propositional and procedural knowledge and skills (ER+) (Table 3.9) to analyse the knowledge code and one portraying the knower code (SR+) (Table 3.10). Through this, I was able to develop what Bernstein (2000) called an external language of description or translation device. Bernstein (ibid.) explained that there are two types of languages of description – an external one and an internal one. The internal one comprises the theoretical framework of the study (see Chapter 2) while the external one reflects the means by which the theoretical language is displayed in the study (Bernstein, 2000, p. 133). It shows the relation between empirical data and the theory. The main categories of analysis are summarised in Table 3.9 and Table 3.10 below, and their application is shown in Appendices 6 and 7.

Table 3.9: Categories of analysis used for analysing the knowledge code (ER+)

Type of knowledge	**As extracted from data in Appendices 6 and 7**
Scientific/specialist knowledge	To have an environment protected for the benefit of the present and future generations through legislations that: Prevent pollution and ecological degradation Promote conservation
Social knowledge / related to people's experiences	To protect the health and wellbeing of the people Everyone has a right to have an environment that is not harmful to his or her health and well being
Technical knowledge	Under chemical recycling process appear the following processes: pyrolysis
Legislative	Waste and management practices require national legislation to maintain essential national standards Require uniform norms and standards that apply
Planning, institutionalisation, roles and responsibilities	Achieving integrated waste management reporting and planning To provide for institutional arrangements and planning matters/ Develop procedures on the reporting on the plans

Table 3.10: Categories of analysis used for analysing the knower code (SR+)

Knower code	**Knower code represented in waste management extracted from Appendix 7**
Political aspects	Waste management in developing countries is influenced by scaring inequalities, varying economic, cultural, socio-economic and political landscapes, governance
Financial / socio-economic	Landfilling is the cheapest and most convenient method of waste disposal
Socio-cultural	WM methodologies need to integrate methodologies that show connectedness of socio-cultural, environmental, economic and technical sphere
Inequalities on places of settlement/places of abode	Those in peri-urban and rural areas have limited access to formal services Waste services not accounted for in rural towns. Staffing in these areas is skewed towards labourers

- ***Analysis of legal frameworks***

I also applied these categories of analysis (see Table 3.6 and 3.7 above) to analyse the two leading waste management legal frameworks which I used in the study, namely the Waste Management Act of 2008 (South Africa, 2008) and the Waste Management Strategy of 2011 (South Africa, 2011) as shown in Table 3.1 above. The knowledge features and the social aspects that emerged out of the legal frameworks are reflected in Appendices 8 and 9 and are further discussed in Chapter 4. As noted in Table 3.1 above, I viewed these as being part of the field of production.

- ***Analysis of questionnaires***

As noted in section 3.4 above, Part 1 of the questionnaire included the biographical information of the officials inclusive of their qualifications, fields of study and information on how and why they worked in the waste section of the department. This was summarised above in Table 3.2. Further analysis of the qualifications and specialist knowledge background of the respondents is reported on in Chapter 4 as this provides historicity to the way in which knowledge comes to be legitimated.

The questionnaires were analysed to establish what the Department officials emphasise as the basis of achievement in waste management. All the sections of the questionnaire were used to determine specialisation, which is about determining the basis of achievement for waste management at the level of production, and here the categories outlined in Table 3.6 above were also used to establish ER+ (knowledge code). As noted above in section 3.4, Part 2 of the questionnaire provided examples of content knowledge that they feel is critical to be included in the training interventions of people at Level 2 who are working within the spheres of waste cleaning and picking. The information suggested was read and sorted into two categories, knowledge with an epistemic relation (ER) and one with a social relation (SR), and this analysis is reported on in Chapter 4. In the third section of the questionnaire, the Likert scale with 11 items was analysed using the responses and how they were categorised by respondents according to quite important, very important, not very important and not important at all. Two of the officials did not respond to this part of the questionnaire. This analysis is also presented in Chapter 4, where the epistemic device and specialisation dimensions are analysed to determine the emphasis of achievement suggested by officials within the Department of Environmental Affairs. This is further triangulated with the data analysis from the research

papers and the legal frameworks. The combined results of this analysis establishes the overall emphasis of achievement and legitimation as found in the field of production.

3.5.2 Analysis of Data in the Field of Recontextualisation and Reproduction: Interviews, Documents and Observations

- ***Analysis of worker interviews***

The interview schedules of the workers were divided into four sections. The first section focussed on the biographical data of the workers which consists of questions around their places of birth qualifications and activities/ job in the project (summarised in Tables 3.3 and 3.4 above in section 3.4.3). The second section of the interview enquired into their existing concepts of waste at their homes and how they managed it. The third section focussed on what they considered as waste in their previous schools and how they managed it. The fourth section focussed on what they considered as waste in the project and how they manage it. Initial analysis of the interviews showed different types and categories of waste identified by workers from home. The categories identified were:

- Organic waste (e.g. old food peels, animal manure, cut grass etc.)
- Recyclables (e.g. old clothes, plastics, steel and tin)
- Inert waste (e.g. rocks, soil, sand)
- Sanitation related waste (e.g. disposable nappies)

I analysed this data of waste concepts from home per worker and also did the same with the data from school and the workplace. I grouped the data according to the types and categories of waste suggested by the waste regulations. Four categories that were present in the waste concepts formed from school include:

- Organic waste (e.g. peels of fruits, food waste)
- Recyclables (e.g. paper and plastic, sweet papers, tin cans)
- Inert waste (e.g. dust, soil, sand)
- Old equipment (e.g. planks from old desks, steel frames from old desks, computers)

How waste is managed at both home and schools was analysed per worker (see Appendix 10). The ways of managing waste raised through this analysis were related to the ways of managing waste as identified at the level of production. Those which were not related to the standards of the specialists and the legal frameworks or those identified at the level of production in the field were also highlighted. They will be discussed in Chapter 6.

The fourth section of the interview focusses on what they consider as waste in the project and how waste is managed in the project. This section of the interview was transcribed by myself,

and inputs were arranged according to the names of the workers. The examples of waste emanating from the projects were grouped according to categories. From this, the following four categories of waste were identified:

- Organic waste (e.g. food thrown away by restaurants and supermarkets, garden waste etc.)
- Recyclables (e.g. plastic and paper, cardboard, glass bottles, tins etc.)
- Inert waste (e.g. soil and sand resulting from sweeping streets)
- Sanitation related waste (e.g. soiled disposable nappies)

The inputs of how the waste is managed in the project were transcribed. They were also tabled per worker. The workers were arranged by names vertically from worker 1 to worker 6. Their inputs were arranged in the cells created according to the categories emerging from their inputs and observations. They were also arranged according to the ways of management which emerged at the level of production. They were arranged according to everyday knowledge and scientific knowledge derived from the field of production. Specialisation, a dimension in LCT, was used to surface the types of knowledge emphasised at this level. The results at both the level of production and project level (level of reproduction) were compared to indicate whether there are similarities or differences between the two. The findings and results originating from these comparisons will be discussed in Chapter 5.

As noted previously, the second interviews were conducted seven months after the commencement of the project. The aim of these interviews was to make sense of what the workers had learned about waste management during their participation in the project (which required probing as noted above). I transcribed the interviews myself in order to create familiarity with the content. Aspects learned were captured and listed per worker and later given codes. The common issues (learnings) that emerged in each project were grouped into categories. The main categories were:

- Specialised Waste Management, for example, sorting, separation, and recycling
- Economic Knowledge: Realised the fact that waste was a resource can assist them to open up businesses.
- Social Knowledge: Realised that the attitudes of people (whether positive or negative) played a great part in waste management.
- Picked up the importance of education and awareness for communities and business people on issues of waste.
- Learned the relationship between waste and other environment issues, namely composting, planting of trees, development of parks using local resources and climate change.

The tables are included in the appendices and are discussed in Chapter 6. In Chapter 6 a thick description of each case was developed tracing the story of each case from the first interviews to the last interviews. This helped to show the development of waste management knowledge and the knower within the life of each case in the project and how waste management knowledge was circulating.

- ***Analysis of recontextualisation tools: Unit standards and training programmes***

Recontextualisation is when and where the knowledge or specialist discourses are selected, decoded and simplified for use in other contexts (Bernstein, 1990). It determines what knowledge is to be selected from the field where it was produced and how it was translated to pedagogic knowledge and practice (see section 2.5.4). One example is where knowledge from the field of production is selected and adapted to the curriculum. In this study, the purpose of the recontextualisation analysis was to lay bare how waste management knowledge is emphasised by the developers of qualifications, skills programmes, the curriculum, and learning materials at Level 2 of the NQF and by the facilitators during training interactions. The documents analysed here are indicated in Table 3.1. They are traced from the qualification to the learning materials of two providers participating in the study.

Initially I thought I would analyse waste management knowledge as it is articulated across all the levels of the NQF from Level 1 to Level 5. This proved too broad a scope, and I then focused in on analysis of knowledge in the Level 2 qualification. The qualification at Level 2 entitled "National Certificate Environmental Practice NQF 2", is composed of a minimum of one 128 credits each consisting of about six to seven outcomes. I started out by thinking that I would look at knowledge in all 6 unit standards (50 credits each), as well as the recontextualisation of those 50 credits in accredited providers training materials and advance to how they are reproduced in workplace pedagogical contexts. However, this was too huge for inclusion within this piece of work. In this research I decided to concentrate on the recontextualisation of knowledge in the qualification, the skills programme, and training materials with emphasis on Unit Standard 11955. In this study Unit Standard 11955 is also named Module 1.

The unit standard at waste management Level 2 was analysed. Waste management knowledge surfacing from it was categorised and tabled. The unit standard's content first was analysed into knowledge categories and later underlying principles (ER+ and SR+) were discussed. The following knowledge categories emerged:

- Scientific/ specialised knowledge inclusive of:
  - Concepts in waste management;
  - Processes in waste management;
  - Procedures in waste management;
  - Practical skills in waste management.
- Values
- Planning and management tools

There are commonalities between categories from the research papers and the one in the unit standard which are arranged in tables in Appendix 5.

The learning materials were analysed using framing/ control. Framing is concerned with the regulation and control of communication in practices (see section 2.5.5.1). Framing relates to how communication takes place between the acquirer and the transmitter of knowledge. Framing is a key concept to account for how knowledge is recontextualised into curriculum and pedagogy, in the case of this study in the Qualification, Skills programme, Unit Standard 119555, and Materials of Provider 1 and 2 via observations and training content analysis.

The specialisation and semantics dimensions of LCT (see section 2.5.5.4) were utilised to analyse the data. The aim of using specialisation data was to identify the waste management knowledge emphasised at the level of recontextualisation while semantics were utilised to determine the degree to which the knowledge relates to the context.

- ***Analysis of observations***

I observed the work training activities for Unit Standard 119555. The activities of each day were audio and video-taped. I observed the characteristics of the pedagogical processes, interactions and individuals during training in the workplace. The aim of the observation was to gain further insight into the structures of knowledge and how it circulates in the workplace via formal training, the different procedures, pedagogies as the lesson unfolds and how the individuals themselves learn and use knowledge. The observations were analysed using framing and classification (see section 2.5.5.1) and later the two dimensions specialisation and semantics. Languages of description were developed for the three ways of analysis to show the translation from the theory to the data. The knowledge in the curriculum (unit standards and materials) and the pedagogy was compared with the knowledge identified at the level of production. The results are discussed in Chapter 6.

3.6 ETHICS AND VALIDITY

The focus of qualitative research is on exploring, examining and describing people and their natural environments. It is full of concepts of relationships and power between researchers and the participants. The research processes have an ability to create tensions between the researchers and the participants. That realisation, therefore, makes it imperative for ethical issues to be considered in any kind of research. Ethics pertains to doing good and avoiding harm. Harm can be prevented through the application of appropriate ethical principles. (Orb, Eisenhauser & Wynaden, 2001, p. 93)

Bassey (1999) discussed ethics under three sections: respect for persons, respect for truth and respect for democracy. In respect of persons, the researcher should take the following factors into consideration. Researchers need to consider that participants have full ownership of the data. People's autonomy needs to respected. Participants should participate voluntarily in the research and should be given a clear explanation of what the research study expects of them. Their dignity and privacy need to be maintained and protected. The research should not bring harm to the research participants or to any other people. Researchers should think of how participants can be negatively affected if personal information about them is made public. They need to know how their work will be publicised. They should be assured of confidentiality of information supplied by them as well as protection of their identities.

In this research as reported on above, I requested access to the projects, participants and workers from the Director General of the Department of Environmental Affairs to conduct research in the DEA-funded EPWP projects and this was granted. I reported the undertaking to the Chief Director of Environmental Protection and Infrastructure Projects (EPIP), the Director of the EPWP Project Implementation Directorate, the Provincial Project Manager and the Provincial Training Manager and the workers. Whenever I visited the project, I requested permission from the Project Implementer and informed the Provincial Project Manager and the Provincial Training Manager in advance. By doing this, I showed respect to the participants and the sites of research. I did not want my presence to disturb their project activities.

As explained above, during the first interviews the research was carefully explained to project implementers and workers, and I requested permission from the workers to involve them in the research. As I work for the Department of Environmental Affairs, I had to take account of the power relations that exist between the DEA and implementation partners and workers; for this

reason it was important for me to assure the workers that they could withdraw from the research should they wish. It was also very important that they understood the purpose of the research and how their contributions would be valued. To further address ensure respect for persons, I used pseudonyms for all the participants, DEA officials and providers in the study so as not to reveal their actual identities.

Validity can be defined as the extent to which a research fact or finding is what it is claimed to be. In asking if research is valid, one is trying to check if the research is justifiable or believable or work that can be trusted. According to post-positivists, it is about how close to the truth about the world the research is. Kvale (1996), cited by Berthram and Christiansen (2014, p. 188), commented that in the positivist paradigm the concepts of generalisation, reliability and validity are seen as the holy trinity "to be worshipped by all believers in science" but Berthram and Christiansen (2014) claimed that the issues are different in qualitative research. They stated that in qualitative research, unlike in quantitative research, measurement is not an issue; however, they realise that qualitative research also needs quality checks. Validity in qualitative research is however different from quantitative research. Different concepts have been adopted; instead of validity, the terms trustworthiness and credibility are utilised. Trustworthiness and credibility describe whether the findings reflect the reality and lived experiences of the participants. They can be enhanced during data generation and data analysis. They also promote respect for truth as researchers are expected to be truthful in data collection. They should not deceive others. During data analysis I promoted trustworthiness by using mechanical means to collect data. For interviews, I used audio-recording devices to collect and to record the data. For collecting of data through observations, I used a video recorder. I transcribed the data myself.

During analysis of data, the mechanical recording devices assisted me to examine the data rigorously. They enabled prolonged engagement with data sources and I was able to conduct a thorough reading and transcription. I constantly asked myself questions to see whether the emerging evidence was true or false. I also had a chance to examine the phenomenon at different times and under different circumstances. I studied the phenomenon at home, school and the projects. I shared the transcripts with respondents to check if they were accurate reflections of what had been said. The data also reflected where the projects were located and where the participants came from.

Triangulation was also used to strengthen validity. Through triangulation I brought together data from different sources. I also used different types of enquiry for getting information from the same source. In the context of this research the same sources are the workers in the EPWP projects. Triangulation forced me to compare one source of data with other sources. The process helped to strengthen the confidence in the statements and claims that can be made from the research (Cohen et al., 2004). Triangulation enabled me to see that the data collected from workers sometimes contradicted the data from the documents. The workers utilised everyday knowledge more than specialised knowledge.

3.7 CONCLUSION

This chapter commenced with explaining the research focus of the study in relation to the data collected. It described the research design and the research methodology for this study. The cases researched, their background, my position in the programme as researcher, and the governing structures of the programme are described. The chapter has explained how I approached the collection and analysis of data. Different tools were used in the collection of data, namely, documents, questionnaires filled in by the officials of the Department of Environmental Affairs, interviews and observations. The manner in which the data was analysed is described. The chapter also provides insight into how I attended to issues of validity and ethics in the research.

The next four chapters report on the findings of this research. Chapter 4 answers the first two questions of this research whose purpose was to investigate legitimate knowledge developed by producers in the waste management field level of production. Chapter 5 reports on the recontextualisation of waste management knowledge from the level of production into the waste management qualifications, programmes and documents at Level 2 of the National Qualifications Framework. Chapter 6 reports on waste management knowledge and the experiences the workers bring to the project. Chapter 7 describes how knowledge is reproduced and evaluated in the waste management Expanded Public Works training activities and workplaces as well as its circulation amongst workers. Chapter 8 reports on the overall findings of the research.

Chapter 4:

Legitimate Waste Management Knowledge and Knowers as reflected in Research and Policy at the Level of Production

4.1 INTRODUCTION

This is the first of the four chapters that report on the findings of this research. It answers the first two questions of this research whose purpose was to investigate legitimate knowledge developed by producers in the waste management field at the level of production. As discussed in Chapter 2, the field of production is where new knowledge is constructed (Bernstein, 1990; Maton, 2013).

The questions read thus:

- What is the structure of legitimate knowledge and the knower in waste management?
- What are the underlying organising principles underpinning knowledge and the knowers in waste management?

The first question as explained in Chapter 1 in section 1.3.2 investigates the structure, the nature, the development and different ways in which what is considered legitimate knowledge and knowers surface within the field of waste management at the level of production. The second question explores the underlying principles underpinning knowledge and knowers at the level of production using the specialisation dimension in Maton's theoretical framework. The findings reported are extracted from the research by specialists in the waste management field, the leading South African policies on waste management and questionnaires which were filled in by specialists in the field working for the National Department of Environmental Affairs (see section 3.4.2). The findings from each group will be reported separately.

4.2 WASTE AND WASTE MANAGEMENT DEFINED

4.2.1 What is Waste?

The National Environmental Management: Waste Act (South Africa, 2008) adopted the definition of 'waste' to mean "any substance, whether or not that substance can be reduced, re-used, recycled and recovered, that is in surplus, unwanted, rejected, discarded, abandoned or disposed of, which the generator has no further use of for the purposes of production" (South

Africa, 2008, p. 16). Waste must be treated or disposed but disposal must be done hygienically so that it is not a nuisance and does not create harmful effects on nearby communities. Often waste is not conducive to a healthy environment and also contributes to its degradation. "A by-product of waste is not considered waste; and any portion of waste, once re-used, recycled and recovered, ceases to be waste" (South Africa, 2008, p. 16). This definition of "waste" has been modified in the revised amended version of the Waste Management Act of 2014 to be "Any substance, material or object that is unwanted, rejected, abandoned, discarded or disposed of by the holder of that substance; the material or object can be reused, recycled or recovered and includes all wastes as defined in schedule 3 of this act (South Africa, 2014, p. 4).

4.2.2 What is Waste Management?

The Japanese International Cooperation Agency (2009) defined waste management as actions to control the sequential process from discharge, storage, collection, intermediate treatment to final disposal of waste materials. This definition of waste management targets all types of waste, whether hazardous or non-hazardous.

According to Marshall and Farahbakhsh (2013), Oelfse and Godfrey (2010) and Al- Salem (2009), currently waste management is called 'integrated waste management', an approach that has emerged from the policy shift away from land filling towards broader perspectives as discussed in section 1.2.3.2. The concept of 'integrated waste management' strives to strike the balance between the following dimensions of waste management, namely, environmental effectiveness, social acceptability and economic affordability.

The approach given above leads to the definition given by Theron and Visser (2010) who said that waste management refers to the collection, transport, processing, recycling or disposal of waste materials produced by human activity. They further commented that traditionally waste management used to refer mainly to the collection and transport of waste to the landfill site but now South Africa is complying with international standards and is paying attention to the 'waste hierarchy' which entails avoidance, prevention, minimisation, reduction, recycling and reprocessing, reuse, recovery, composting, treatment and disposal of waste as the last resort (as mentioned in section 1.2.3.2). South Africa now pays attention to the recycling of waste materials as part of a waste minimisation strategy and large numbers of people are employed both in collection of waste and in different processes of recycling, for example processes of recycling paper, plastic, glass, tins and tyres.

In South Africa within environmental education, environmental legislation and research, it has been realised that poor waste management systems have detrimental effects on both humans and the environment. Despite this realisation, most of the waste is still disposed to landfill in spite of commitment to comply with international standards that pay attention to the waste hierarchy.

The Third National Waste Baseline Report of 2011 conducted by Council for Scientific and Industrial Research (CSIR) and the Department of Environmental Affairs shows that South Africa generated approximately 108 million tonnes of waste in 2011. Of this, 97 million tonnes was disposed in landfills. Of this, 59 million tonnes is general waste while 49 million tonnes is unclassified and hazardous waste. Only 10% of all waste generated in South Africa was recycled in 2011 (South Africa. DEA, 2011). The information above shows that most waste in South Africa still ends up in the landfills though there is call for compliance to the waste hierarchy. It also shows that most of the waste produced is general waste which forms the greater part of waste produced in the municipalities including rural municipalities.

In response to this, the Department of Environmental Affairs established waste projects in municipalities to curb this health and environmental hazard; subsequently the workers undergo training in waste during the implementation of waste projects but the effectiveness of this process can be questioned as sometimes project areas return to their former state when the projects have come to an end, as mentioned in Chapter 1, providing the impetus for this study.

As discussed in Chapter 2, the level of production represents the intellectual field of the system, where individual researchers and research groups at various universities and research institutions produce new ideas, theories and specialised discourses. Texts produced by this level of production include academic articles and reference books (Bernstein, 2000). As noted in Chapter 2, Maton (2007) argued that the intellectual and educational fields involve more than knowledge structures as discussed by Bernstein; they also include the structure of knowers. He believed that for every knowledge structure there is a knower structure. He shows how the two can be brought together and how their underlying structuring principles can be analysed, which is the reason why the knower element is included in the questions of this research. According to Maton (2010, p. 43) when a field is analysed, the following come up: "viewpoints and practices of participants, the ways in which they represent themselves, their beliefs and practices whether explicit, implicit or tacit". These personify messages as to what should be considered legitimate. I now turn to a more detailed analysis of this.

4.3 BACKGROUND OF KNOWLEDGE PRODUCERS INFLUENCING THE TYPE OF KNOWLEDGE PRODUCED IN THE RESEARCH ANALYSED IN THIS STUDY

Conforming to the social realist argument that "all knowledge is socially produced by communities of knowledge producers and is real because it is about an objective world" (Howard & Maton, 2011, p. 194), I commenced by identifying who the specialists were in the field of waste management, as described in Chapter 3. In Chapter 3, I provided an overview of the fields of specialisation and institutional affiliations of the authors of specialist research papers (see Table 3.1) and the disciplinary backgrounds of the DEA officials that responded to the questionnaires (see Table 3.2).

Table 3.1 in Chapter 3 summarises the interdisciplinary fields of specialisation of authors of the papers. There are more authors than papers because of co-authoring of papers. As shown in Table 3.1, most of the knowledge producers in waste management are affiliated with Environmental, Engineering, Planning and Development, Consumer Sciences and Law and justice disciplines. In the Environmental Sciences, there were specialities in different disciplines, namely natural resource management, environmental science, environmental management, consumer studies and natural sciences. In Environmental Engineering, the disciplines are inclusive of engineering process systems, engineering, and environmental science and engineering disciplines. Planning and development is inclusive of planning and urban development, architecture and planning and energy. All these disciplines address the impacts of waste on the environment from different perspectives. Most of these disciplines are affiliated with the natural sciences, engineering sciences and the planning sciences. The producers from the social sciences disciplines are few which shows that most of the researchers in waste management have their background in the natural sciences.

The biographical data of the officials in the chemical and waste branch of the Department of Environmental Affairs also shows the same interdisciplinary features as those researchers active in waste management research that is relevant to the focus of this study (i.e. solid waste management in municipal contexts and the waste hierarchy).

Most of the specialisations related to waste management knowledge production, as shown by the DEA officials profiles, are in the natural sciences and /or engineering related fields, namely chemistry, meteorology, environmental engineering, pollution/toxicology management, environmental impact assessment, civil and chemical engineering. Additionally, because of the policy focus which I have included, there is also specialisation in law and policy formulation.

According to Bernstein (1996, 2000), natural sciences have a hierarchical knowledge structure while the humanities and social sciences have horizontal knowledge structures. Bernstein's explanation of structures of knowledge commences by separating them into horizontal and the vertical discourses as explained in Table 2.1 of section 2.5.3. As noted in Chapter 2, the horizontal discourse represents everyday common language while the vertical represents theoretical, specialist, or abstract language. He then further divided the vertical discourse into hierarchical and horizontal knowledge structures (see section 2.2). Knowledge with a hierarchical structure is explicit, coherent, and systematically principled, while horizontal knowledge has a series of specialised segmented structures each with its own specialised criteria. If the producers belong to the natural sciences, the likelihood is that the emphasis will be on vertical, specialised scientific knowledge and this indicates they are likely to be purporting specialised knowledge with structured, explicit scientific procedures. This indicates that specialists are likely to concur that the structure of waste management knowledge is vertical or explicit and scientific.

While both groups have qualifications in the natural sciences and engineering, some of the content in the waste management papers and also some of the profile data of the DEA includes elements of knowledge from the social sciences. This reflects the interdisciplinary nature of waste management knowledge, which will be clarified as the chapter unfolds.

The specialists from the DEA concur that in South African institutions of learning, waste management is not offered as a discipline by itself; it is offered as a module in the following qualifications: environmental engineering, environmental sciences, environmental management, environmental health, and civil and chemical engineering. They concur that waste management is offered by both research-led universities and universities of technology in South Africa. In some of the universities it is offered in Masters degrees at postgraduate level as a specialist option. Some have studied waste management as a module but others have completed pure science degrees majoring in chemistry and physics. They have found chemistry useful in the study of waste management. Others have studied waste management in short courses. Those who have specialised in chemistry found their chemistry expertise useful to understand the pollution emanating from various chemicals. One of the respondents (Desmond) commented that negotiations are in the pipeline for waste management to be introduced as a qualification in two of the South African universities. The knowledge they emphasise as the

basis of achievement in waste management will be described in forthcoming paragraphs and is evident in these citations.

> Sister A: As I learned about waste management, I realised that it was very interesting and had more to it than what I initially thought. The science behind it fascinated me as I did not think of it as a scientific field.
>
> Desmond: A background in chemistry is vital. Waste characterisation and classification is based on the chemical composition of waste. My interest in applying chemistry in waste management, particularly hazardous waste influenced me to have an interest in waste management.
>
> Khalo: Waste management is very interesting and covers all sectors of the economy. The impacts of bad waste management can be severe and will be felt by generations to come.

The first two officials above concur that initially they did not see waste management as a scientific field, and while studying and working in the field they were fascinated with the application of science in waste management. In this context, the scientific field and science behind waste management referred to above, are referring to the natural sciences. The first respondent cited above indicates that there is science behind waste management while the second respondent indicates that a background in chemistry is vital because waste characterisation and classification are based on the chemical composition of waste. The third official reflects a view that waste management is more interdisciplinary as it covers all the sectors of the economy. Her comment concurs with the comments below from the researchers which indicates that waste management is a multi- and interdisciplinary 'amalgam' of content from a number of disciplines.

> Historically public health concerns, scarcity of resources and aesthetics have been drivers of waste management systems. (Worrel & Versilind, 2012)
>
> Prior to the year 2000 developed countries never considered social aspects. They focused only on economic and environmental aspects [of waste management]. (Marshall & Farahbakhsh, 2013, p. 988)
>
> When progress in waste management finally began it was driven by five factors namely, public health, environment, resource scarcity, the value of waste, climate change, public awareness and participation. (Marshall & Farahbakhsh, 2013, p. 989)
>
> The waste management global partnerships report in WM of year 2011 identified priority areas in WM as being capacity building, technical and scientific, financial, policy and regulatory, research and development in landfilling in waste management. (Godfrey, 2011, p. 2)
>
> Waste management has a scientific touch that increases understanding of the problem of lead pollution. It provides concrete knowledge that leads towards preventive or remedial action. Natural and social sciences contribute to social justice and behavioural issues. The coupling of science and experience / practice is the mix that produces interesting articles and advances

> in sustainable development of resources and waste management at a global scale. (Hansen & Newman, 2012, p. 1)

Listed above are citations from the papers produced by different waste management researchers analysed in this study (refer to Table 3.1). They show that waste management is inclusive of a number of contributions from different disciplines. The finding surfacing from this analysis of waste content knowledge signifies that waste management knowledge is multi- and interdisciplinary. Its content is influenced by elements of knowledge from different disciplines. According to Bernstein (1971), when a study field contains elements from a range of disciplines it shows that its boundaries of insulation are blurred.

Secondly, the findings point out that waste management knowledge develops and changes within time and space. This is in line with the ideas of Bourdieu (1985) which are cited by McNamara (2007, p. 16), who indicated that "fields are not static, they are dynamic". Their dynamism arises from the fact that fields are populated by actors struggling over status and resources in order that they can have a good standing and position within the field. Looking at the extracts above one can trace some of the gradual changes within the field. It once addressed public health, resource scarcity (environmental), economic and aesthetic issues only, and subsequently went on to adopt a 'scientific touch' to understand the issues of pollution. More recently, it went further to accommodate the social justice, public awareness, participation, climate change and technical aspects. Different aspects of the disciplines are subsumed and expanded as the waste management field develops.

Bernstein addressed this phenomenon in a number of theories. He used power (classification) and control (framing) to describe the scenarios. He said that power always operates to create dislocations and boundaries between categories (Bernstein, 2000). Applying Bernstein's (2000) view, it is possible to suggest that as different disciplines are surfacing and are part of contemporary waste management, this depicts that the boundaries between waste management knowledge and that of the other disciplines is gradually disintegrating, a view which is further illustrated in the historical perspectives (see section 4.4.2 below).

Bernstein (2000) introduced the concept of classification and the metaphor of boundaries to explain this disintegration of boundaries between categories. Classification is defined as "the strength of boundaries between contexts and categories", where contexts and categories can be knowledge, curricula, fields, disciplines, institutions and subject areas (Bernstein, 2000, p. 52). The boundary between categories can be strongly classified or weakly classified. In this study

category 1 is waste management specialist knowledge and other categories or category 2 is content from other disciplines. The classification may be strong (C+) or weak/blurred (C-). The explanation of this phenomenon is explained at length in section 2.3.2 in Chapter 2. When the classification is strong (C+), it means there is a strong insulation between the categories and the relations are kept far apart i.e. boundaries are strong. In such a scenario, knowledge is a specialist arena and staff are tied to their specialist departments. Their knowledge is not exposed to the outside world or to a wider range of disciplinary interactions. Even promotion comes from within. When the classification is weak (C-), the insulation between the categories is blurred, boundaries are weak, and things are brought together often in multi- (more than one discipline) or inter-disciplinary (merging of disciplines) or even transdisciplinary (inter-disciplinary and applied theory / practice) configurations.

The diverse institutional and scientific contexts in which knowledge is produced (see Table 3.1 and Table 3.2) as well as the extracts from research papers above show that the relations between waste management knowledge and other disciplines are integrated.. Waste management is interdisciplinary as it is an emerging study field that shows knowledge aspects from science (natural sciences) and social sciences/ humanities. Chemistry and physics in natural sciences form the background of the waste management knowledge as per the comments from Desmond and Sister A which are confirmed by Hansen and Newman (2012). They commented that "the coupling of science and experience/practice is the mix that produces and advances sustainable development and waste management at a global scale" (Hansen & Newman, 2012, p. 2).

Bernstein (2000, p. 54) further distinguished and packaged knowledge into singulars, regions and generic modes. Singulars are comprised of academic disciplines that address a discourse which is only about itself. Such disciplines have specialised knowledge structures. They were established at the time when the need for specialised knowledge among differentiated divisions of labour was realised.

Regions are at the interface between academic disciplines (singulars) and the fields of practice. Regionalisation involves the technologising of knowledge, and a region can be seen as an interface between the field of production of knowledge and any field of practice. It is also referred to as an applied disciplinary knowledge field which underpins professional practice (Young, 2006, p. 55). Regions draw on, integrate and recontextualise knowledge as the

theoretical basis of practice in occupations and professions. Growth of regions is associated with the growth of professions (Wheelahan, 2010, p. 24).

The implications above are relevant to waste management with reference to aspects surfacing from the data. From the above discussions, it is clear that *waste management is an example of an inter-disciplinary knowledge region,* not a singular. The boundaries between the qualifications, fields of specialisation of the staff, disciplines and the discourses are permeable. There is a high level of interference from outside (being other disciplines) into waste management and the communication from outside is less controlled. Specialists from other disciplines, for example, planning, law and energy can write on waste management as it impacts on their fields. The staff are a part of a social network as the relations between the staff cohere around knowledge itself. Waste has an impact and waste management knowledge is applied to a number of disciplines, social contexts and companies namely environment, public health, economics, natural resources, industries, municipalities, and civic-based social justice contexts. It needs technical expertise and capacity building into which people are socialised. All these groups need waste management knowledge (which is a mix of natural scientific, engineering, legal, social scientific as well as practical knowledge) as a basis for them to apply it in their different contexts. It involves the coupling of science and experience/practice (Hansen & Newman, 2012) or what Bhaskar (1998) would refer to as 'theory-and-practice-in-practice'.

Several underlying principles need to be considered when using specialisation. According to Maton (2004), the epistemic code (ER+/SR-) emphasises or makes reference to specialised knowledge, skills, procedures and techniques while the social (knower) code (SR+/ER-) emphasises personal characteristics, dispositions, values of the author/agent. The elite code (SR+/ER+) emphasises both the possession of specialist knowledge, procedures, skills and techniques (knowledge code ER+) and the right kinds of dispositions (knower code (SR+) while the relativist (SR-/ER-) does not have any of the two. Specialisation is therefore used in this category to determine the basis of emphasis/ legitimacy of waste management highlighted by the backgrounds of the researchers at the level of production. It has been realised that both Epistemic Relations (ER) and Social Relations (SR) are surfacing from the specialities of the researchers but the fields of science are more conspicuous than the social disciplines, showing therefore that through the backgrounds of the researchers, the epistemic relations (ER) are emphasised.

4.4 LEGITIMATE WASTE MANAGEMENT KNOWLEDGE AND KNOWERS AS PRODUCED BY RESEARCHERS IN THE FIELD OF PRODUCTION

4.4.1 Legitimate Waste Management Knowledge as found in selected research papers

The findings on knowledge from the waste management research papers discussed above are further clarified by analysis using the different types and forms of knowledge as outlined in Table 3.6, which, as noted, is also based on Bernstein's work. Out of Bernsteinian and other scholarship on knowledge, it is possible to differentiate between two types of knowledge meanings, those tied to the context of thought and reasoning (TYPE 1) and those which are generated in a context of human action (TYPE 2). The type of knowledge which is tied to the context of thought and reasoning is termed context-independent, theoretical and abstract knowledge. Anderson (1982) termed it propositional or declarative knowledge. According to Gamble (2006, supported by Evans, 1993) this knowledge ranges from simple factual knowledge to deeper levels of conceptual knowledge and to problem-solving knowledge. It facilitates the resolution of problems, which would seem to be helpful to an emerging knowledge field such as waste management which has as its *raison d'etre* the solving of environmental problems of waste. Classified under this type is propositional (knowledge what) and procedural knowledge (knowledge how).

The type of knowledge which is generated in a context of human action, termed context-dependent, derives its meaning from concrete events and experiences that happen in a specific time and place. Such knowledge is always tied to the real world; it is applied and/or emergent from context and action. In my analysis, I identified technical knowledge, social knowledge (being inclusive of people's dispositions, values and attitudes), vocational / craft knowledge, practical, historical, legislative and economic knowledge as reflecting this type of knowledge (Type 2 knowledge), which is generated in a context of human action, and which is more context-dependent. In the case of waste management economic knowledge, I focussed on applied economic knowledge rather than propositional economic knowledge, as this seemed to be what was reflected in the papers being analysed.

I developed an analysis of the types of waste management knowledge found in the research papers drawing on this framework which I present in Table 4.1 below. Table 4.1 indicates the types of knowledge surfaced in the research papers, indicators of these types of knowledge, and some examples from the documents. As can be seen from the analysis in Table 4.1, some

of these types of knowledge overlap, for example, procedural, technical, vocational and practical knowledge but differ in terms of application and contextual emergence.

Table 4.1: Types of knowledge surfaced from the research papers with indicators and examples from the research papers

Type of knowledge	What it entails	Indicators	Examples from the empirical research papers	Authors
TYPE 1: KNOWLEDGE Propositional knowledge/ context independent knowledge Theoretical/ Abstract	What exists only in abstract form	*Definitions* *Names of things* *Concepts, deeper level of concepts* *Types of things* *Facts and propositions*	**Waste:** Any matter whether gaseous, liquid or solid that is discarded and not being used *(involves physical and chemical scientific knowledge to differentiate substances*) **Waste types picked up e.g** Organic/ biodegradable waste, Paper, Cardboard Non-bio-degradable Plastic, Glass Inorganic waste *(involves chemical and physical science knowledge; knowledge of materials)* **Categories of waste:** Domestic and household waste – comes mainly from residential areas etc. Hazardous and non-hazardous waste (*involves chemical scientific knowledge)* Industrial waste **Generators of waste:** Retail supermarkets and shops; households; industries **Treatment methods** *(involving chemical, physical, biological and civil engineering knowledge)* *Purpose of treating waste:* To convert it into non-hazardous substances *Encapsulate* it used so that waste does not migrate and present hazards when released into the environment. *Encapsulation techniques* are necessary for inorganic wastes such as those containing toxic heavy metals. *Different methods of treatment:* chemical, physical thermal and biological. Chemical – includes the following processes: neutralisation, oxidation reduction, precipitation and hydrolysis *Composting:* The process of turning organic matter into waste fertiliser through aerobic fermentation. Fertiliser can be used in lawns and gardens. Composting is minimally used in Accra. Only 10 to 15% is composted of 1 250 tons of garbage collected. *Incineration:* A method of burning waste that is combustible at high temperatures of about 1000 degrees Celsius to reduce waste to ashes. It is used as a disposal technique for medical waste.	Godfrey (2008) Mokgae (2011) Muzenda, Mohammed, Belaid, Mollagee, Motampane, Ntuli (2011) Marshall & Farahbaksh (2013) Mokgae (2011)
TYPE 1: KNOWLEDGE	Derived from concrete events	Experiences that happen	Minimising waste Maximising environmental potential through waste reuse & recycling	Godfrey (2008)

Procedural / processes / methods	Knowledge *how* (knowledge of methods and approaches)	in a specific time and space	Waste disposal and treatment Waste reduction to reduce production of waste for final disposal *(involving mainly engineering processing knowledge)* **Chemical disposal** includes processes and methods of neutralization, oxidation reduction, precipitation and hydrolysis *(involves mainly chemical engineering knowledge)* **Physical disposal** includes the processes and methods of encapsulation and filtration *(chemical and physical sciences and engineering)* **Thermal methods** include processes of converting waste into non-hazardous form and reducing volumes, which allows opportunities for recovery of energy from waste *(engineering knowledge)* *In most of the papers, the emphasis is on the how, not necessarily the specific concrete context, although this is implied and in general the processes refer to waste management methods and approaches relevant to developing country contexts and municipal solid waste management contexts as this influenced the selection of the papers as noted in Chapter 3.*	Marshall & Farahbaksh (2013) Mokgae (2011)
TYPE 2: KNOWLEDGE Technical Knowledge	Pertains to an art or technical skill Includes theory and practice Limited to instruction in the principles of science and art applicable to industry Colleges provide for the theory and practice is done in industry context – as industries did not want to expose their art	Includes theory and practice Instruction in the principles of science and art applicable to industry	Waste management processes or changes taking place at the level of waste generation • Separation and sorting at source • Waste minimisation • Reuse and recycling of waste *(One needs knowledge of what to separate/ sort from what, when and how i.e. technical application of engineering knowledge)* **Treatment Methods** involves both technical knowledge and practical skills used to convert waste into non-hazardous substances, involving *encapsulation* processes (named above) so that waste does not migrate and create environmental hazards when released into the environment. *Encapsulation* techniques are specialised according to type of wastes, and are necessary for inorganic wastes such as those containing toxic heavy metals. There are four different methods of treatment – chemical, physical, thermal and biological, each with their own specialist technical and practical approaches e.g. chemical processes included neutralisation, oxidation reduction, precipitation and hydrolysis. *Incineration:* Incinerators are in the form of open pits used to burn bandages and blood products. After burning ash is moved straight to a landfill.	Godfrey (2008) Marshall & Farahbaksh (2013) Muzenda, Mohammed, Belaid, Mollagee, Motampane, Ntuli (2011) Mokgae (2011) Thompson (2011)

TYPE 2: KNOWLEDGE Social knowledge Dispositions, values and attitudes	Pertain to experiences and the values the participants have developed from young	Includes values and attitudes developed through interactions in contexts and society	Public awareness and attitudes towards waste impact on waste management systems from household storage to separation and waste reduction In some areas, for example, waste collection is not seen as an honourable profession. Environmental awareness and information health risks are communicated to all sectors of the population.	Zurbrugg (2003) Marshall & Farahbaksh (2013)
TYPE 2: KNOWLEDGE Vocational / craft knowledge	Acquired through apprenticeship Cannot be acquired other than by doing	Learning a skill with support from a skilled employee	Separation and sorting at source Waste minimisation Reuse and recycling of waste Waste disposal methods that are specific to particular contexts	Mokgae (2011)
TYPE 2: KNOWLEDGE Practical knowledge	Resulting from practice, action and dependent on activities	Learning a skill through practice and taking action	They conduct clean-ups and awareness campaigns, waste collection and street- sweeping activities. It also created further activities such as resource recovery and recycling. Separation and sorting of waste at source. Waste pickers collect and sort the waste on behalf of merchants, recycling firms and composition units.	Theron & Visser (2010)
TYPE 2: KNOWLEDGE Historical Knowledge	Makes reference to how processes change within time and space	Waste management processes changing within the space of time/within space and space	Humans produced solid waste since the time they developed into non-nomadic societies. During this time community were still small and rural and they disposed their waste by burying it outside their settlements and in rivers. Historically waste has been deposited on land. As populations increased the issue of waste became environmental and a socio-ecological aspect. Environmental movements brought the waste disposal issue to the political agenda and regulations addressing water pollution and waste emerged. Emphasis of collection and transport of waste to the landfill site (from cradle to grave approach) has been the practice from the 1900 – 1970s. Recently the focus is on the whole waste hierarchy, which includes reduction, re-use, and recycling.	Marshall & Farahbaksh (2013) Kumar & Pandit (2013) Godfrey (2011)
TYPE 2 KNOWLEDGE Waste management	Makes reference to legislative frameworks within the countries	Information from legislative frameworks	It has emerged from a policy shift away from landfilling to the waste hierarchy. White Paper on integrated pollution and waste management (2000) emphasises a shift from control to prevention.	Godfrey (2011) CSIR & DEA (2011) Thompson (2011)

legislative knowledge			There are policies in Ghana guiding the use of incinerators. Incinerators are in the form of open pits used to burn bandages and blood products. After burning ash is moved straight to a landfill.	
TYPE 2 KNOWLEDGE Practical / applied economic knowledge	Show some reference to monetary issues and entrepreneurship issues applied to waste management	Monetary and business issues	Job creation and social upliftment Entrepreneur development based on economic viability of waste management activity Waste dealers- buy from pickers and buyers concentrated around the dump sites not found in high income areas as they are serviced by private collectors	Theron and Visser (2010)

As can be seen from Table 4.1 above, both context-independent and context-dependent types of knowledge are visible in the research papers focussing on solid waste management in municipal contexts which take account of the waste hierarchy. The following types of knowledge were identified: propositional, procedural, technical, social, vocational/craft, practical, historical, legislative and applied economic knowledge. What is also evident from the table above, is that these types of knowledge are closely associated. Procedural or context independent knowledge is closely associated with the technical processes of waste management, and also with the procedural aspects of waste management (how the waste is to be managed using different methods and processes). Social, historical, craft, and applied economic knowledge involves various applications or actions in relation to, or drawing on propositional, procedural and technical knowledge of waste management.

As shown in Table 4.1 above, propositional knowledge involves the knowledge embedded in definitions and concepts, for example, the chemical and physical science knowledge necessary to differentiate between liquid, gaseous and solid waste forms, or between hazardous and non-hazardous, biodegradable or non-biodegradable types of waste. It also includes factual knowledge to provide for deeper levels of conceptual knowledge and knowledge necessary for problem-solving, for example, the knowledge necessary for different ways of treating different types of waste such as thermal, chemical or physical treatment, encapsulation, incineration etc. It exists in abstract form.

Procedural knowledge is derived from concrete events and can also be described as knowledge *how*. Table 4.1 shows that procedural knowledge related to waste management in the municipal solid waste management contexts relies heavily on engineering sciences (chemical and civil) as well as on chemical and physical sciences. The focus is on developing methods and processes for treating and processing different types of waste according to its chemical and physical composition. As can be seen from Table 4.1, this knowledge is closely related to, and draws heavily on, propositional knowledge for technical solutions, which produces technical knowledge of an applied kind, where the propositional and procedural knowledge is applied to enable solutions to waste management problems.

Table 4.1 above also shows that in the research papers, propositional knowledge, procedural knowledge and technical knowledge (all of which are closely related) appears to dominate, especially in relation to types of waste, and methods and processes of dealing with the waste. Most of the time, theory and practice of waste management in the municipal waste management

context appears to be limited to instruction in the principles of science and the practices or technical methods of waste disposal and processing. The detail of the chemistry, physical, biological or engineering scientific knowledge is not shared but is rather embedded, or assumed to be understood. It is clear, however that waste managers or waste management practitioners in municipal contexts would need theoretical waste management knowledge to apply it in practical activities conducted in waste management. For example, for one to sort, separate, reduce, reuse and recycle one needs to understand what needs to be separated and sorted, how it should be separated and sorted. For one to treat and dispose of waste, one needs to understand the chemical basis of the waste that needs to be treated and at least some of the technical engineering principles of the waste disposal and processing methods. This is confirmed by Hansen and Newman (2012) who noted that the coupling of science and experience / practice is the mix that produces interesting articles and advances in sustainable development of resources and waste management at a global scale.

Both vocational / craft knowledge and practical knowledge bear the same characteristics: they result from or emerge from practice and action and depend on activities, they are related to the development of skills; the difference is that application is in different contexts, leading to different types of craft/vocational knowledge emerging. For example, one person might become an expert at composting (i.e. dealing with biodegradable waste) while another person might become an expert at plastics separation and sorting. Both people would need knowledge of the different types of waste and of concepts of non-biodegradable and biodegradable, but would use this differently depending on the context and type of waste they are dealing with. Craft /vocational knowledge is normally acquired mainly through apprenticeship i.e. one learning a skill from a more skilled employee, while practical knowledge is acquired in any activity dealing with action and practice. In the context of the EPWP programme, an example of practical knowledge would be gained by being involved in practical sorting of waste, but craft knowledge would be gained by learning how to make good quality compost from someone who is very knowledgeable about what makes good compost from diverse types of organic waste. Because they deal with knowledge *how*, in this research I include these types of knowledge under Type 2 procedural knowledge, as shown in Table 4.1.

Historical knowledge reveals the development of specialist waste management knowledge within this interdisciplinary knowledge ‘region’ over time (as this emerging knowledge arena or ‘field’ was typified above in section 4.3.1 using Bernstein’s categories). Historical

knowledge makes reference to how processes change within time and space. Table 4.1 above indicates that there appear to be key shifts that have taken place in the development of waste management knowledge, from earlier disposal in land and water (rivers) to development of chemical and civil engineering solutions to waste disposal (e.g. thermal, chemical and physical disposal methods), to cradle to cradle approaches involving the whole waste hierarchy (see section 1.2.3). It is this history that has resulted in increased specialisation of knowledge related to waste management (ER+), which I will discuss in more detail in the next section (section 4.4.2).

Legislative knowledge makes reference to legislative frameworks that guide waste management activities within specific countries. Table 4.1 shows that policy and legislation tends to 'concretise' the propositional, procedural and technical knowledge that guides practice. For example, policy requires giving attention to prevention and the waste hierarchy, not only landfilling and waste disposal. It can also be quite context specific as in the case where the policy guidelines on incineration in Ghana set up a specific way of approaching incineration in this context. This may be different to the way in which incineration guidelines in other places (e.g. the UK) are defined, where different waste incinerator, co-incinerator or small waste incineration plants have to meet different requirements[3] and thus incineration practices may be different in these contexts.

Table 4.1 shows that economic knowledge as found in the papers selected to guide an understanding of waste management knowledge in municipal solid waste management contexts that take account of the waste hierarchy, deals mainly with the development of entrepreneurial skills, monetary exchange potential, and job creation issues which emerge out of the waste practices. Waste has been identified as a resource with applied economic development and job creation potential. Its activities like recycling have an ability to create jobs. There are waste pickers who pick up waste from the street and sell it to buyers and buyers sell it to waste dealers. Waste has created an economy with potential for expansion within the wider green economy.

Propositional knowledge (theoretical/ scientific/ abstract/ specialist knowledge) and procedural knowledge (procedural, technical, craft / vocational, legal, economic as outlined in Table 4.1) are classified under the *epistemic relation* (ER+) in the Legitimate Code Theory by Maton (2004). From the above analysis presented in Table 4.1, it is therefore clear that in the papers

[3] https://www.gov.uk/government/publications/environmental-permitting-guidance-the-waste-incineration-directive

selected to guide an understanding of waste management knowledge in municipal solid waste management contexts that take account of the waste hierarchy, the emphasis is mainly on propositional and procedural knowledge types, i.e. a strong epistemic relation (ER+).

As can be seen from Table 4.1, social knowledge inclusive of dispositions, values and attitudes, is a Type 2 knowledge, as it pertains to experiences and values of participants in a knowledge practice arena. It also refers to the values and dispositions that the participants have developed from young through interactions in and with contexts and society. This type of knowledge has also surfaced from the research papers data. Here the emphasis is on public awareness and attitudes towards waste and how these impact on waste management systems from household storage, to separation and waste reduction. The interest in social upliftment via job creation associated with the applied economic knowledge also shows some social interest. It is also related to health risks and public health threats, and to the status of waste management as a profession. Maton (2004) categorises social knowledge under the knower code or *social relation* (SR) to the subject. While mentioned in some of the papers (Zurbrugg, 2003; Marshall & Farahbaksh, 2013), social knowledge relevant to waste management was not a major focus of the papers selected and analysed for this study, and one can therefore conclude that overall waste management knowledge as produced in the field of production within the specific focus chosen for this study, carries a weak social relation (SR-).

There is of course also the underlying purpose of waste management overall, which is to reduce public health risk which provides a strong social relation (SR+) impetus for the development of the interdisciplinary knowledge 'region', but the strong social relational (SR+) *purpose*, is not strongly reflected in *the type of knowledge produced*, which carries a strong epistemic relation (ER+).

In this category drawing on the explanations of Table 4.1, it has been realised that both knowledge code or Epistemic Relations (ER) and the knower code or Social Relations (SR) are surfacing from the waste management knowledge produced by the researchers in the field of production but the epistemic relation or the knowledge code (ER+ SR-) is more emphasised than the knower code.

4.4.2 Legitimate Waste Management Knowledge and Knowers as Identified in the History of Waste Management (as documented via research papers)

The research documents on waste management knowledge read and analysed at the level of production in this study signify that waste management practice has a history and is developing with time, with associated specialist concepts. The historical development of waste management, origins and the significance of waste management and its processes thereof are discussed below, specifically to show the emergence of increased specialisation of knowledge. This historical perspective is also based on the research papers selected for review.

From the data it has been realised that waste management practices are as old as humans themselves. Louis (2004), cited by Marshall and Farabakhsh (2013, p. 989), indicated that humans have been producing *and managing* waste since the time they developed from nomadic to non-nomadic societies around 10 000 BC. As they were still few, they had no facilities that catered specifically for waste disposal; they simply buried solid waste outside their settlements and disposed some of it into nearby rivers. As population densities increased the practices above were no longer a solution, as waste accumulation in growing settlements resulted in the spread of diseases. Louis (2004) described city streets covered in stinking mud composed of soil, stagnant water, household waste and animal and human excretion which resulted in diseases.

Cities, communities and countries had to come up with strategies to curb the accumulation of waste. The early Greeks issued a decree banning waste disposal in the streets. They organised the world's first acknowledged *municipal dumps*[4] in 500BC and early Chinese cities established 'disposal police' for enforcing *disposal laws*. In early American settlements, the urban population lived in dirt. Later, however, scarcity of resources led to strategies to reuse and repair of some waste items (Marshall & Farabakhsh, p. 989, referring to Louis, 2004). This shows early development of concepts of waste disposal, reuse and repair, and early legal procedures and legislative knowledge associated with waste management.

Historically, public health concerns, security, scarcity of resources, and aesthetics were the drivers of waste management systems development (Wilson, 2007; Worrel & Versilind, 2012). Further progress in waste management was driven by expanded public health knowledge (e.g. knowledge of waste and disease relations), the value of waste, climate change, and by the

[4] In this section I italicise key concepts that show development of waste management knowledge.

emergence of education, public awareness (as education systems developed) and wider forms of public participation under modern democracies. Between 1790 and 1850 the practices of *reuse* were expanded as households in London were cooking with coal which resulted in high ash content as household waste. That created a market for waste collection, which was used as a raw material to make bricks. In 1830 a problem of sanitation arose in London and a relationship was identified between diseases and poor sanitation conditions. Government developed an interest in better solid waste management.

From 1848 to 1875 Public Health Acts were established in London. The government regulated household disposal of waste into a movable receptacle which local authorities were responsible for emptying weekly, leading to expansion of concepts of *waste collection and waste governance via disposal to dumpsites and later landfill sites*. Similar acts were developed and implemented in other European countries and American cities. From 1900 – 1970 disposal was the most widely utilised approach to waste management but disposal was largely unregulated and uncontrolled, consisting mainly of a mixture of dumping and burning (Wilson, 2007; Louis 2004). After World War II landfilling or disposal was the principal waste disposal method.

Between the 1960 and 1970s the emergence of environmental movements brought waste disposal and pollution onto the political agenda in industrialised countries. New legislation addressing water pollution and waste management emerged following major pollution and waste management disasters such as the Love Canal disaster in which 21 000 tonnes of *toxic waste* was buried under a site near the Niagra Falls, which later collapsed seeping out toxins that created major health problems for school children and local families on the land.[5] This legislation mainly targetted the elimination of uncontrolled disposals. The development of legislation in this period raised environmental standards to reduce the contamination of air, land and water. From 1970 to the 1980s waste management policy focused on *waste control measures* such as covering and compacting of the landfills. These waste policies have continued to date and are the most widely used policies in most African countries, as discussed in Section 1.2.3.2. They are focused on *technical standards* for managing aspects such as landfill-gas, leachate control, incinerator gas and dioxin reduction (Wilson, 2007; Wolsink, 2010) and are reliant on chemical and physical science and engineering solutions, which

[5] http://www.mnn.com/earth-matters/wilderness-resources/photos/americas-10-worst-man-made-environmental-disasters/love

explains the emergence of the dominance of this type of knowledge in waste management specialisation.

In the 1990s integrative policies gained momentum. It was evident that advocating for environmental protection via technical solutions was not enough and an integrative policy which included political, social, financial, economic and institutional elements of waste management was realised under the concept of *'integrated waste management'* (Wilson, 2007; Wolsink, 2010). This explains the expanding range of disciplinary involvements in the construction of waste management knowledge, and its current multi- and interdisciplinary nature, and also the finding above in which I describe waste management as a 'region' drawing on Bernstein's (2000) framework.

Resource scarcity has also influenced the development of specialisation in waste management. In pre-industrial times, resources were relatively scarce and anything vendible (commercially viable) or marketable in the waste stream was scavenged and goods were *reused* and *repaired* rather than being thrown into the waste stream. As cities grew in size during the industrial revolution the resource value of waste rose again and 'rag pickers' or street buyers collected, used and sold materials from the waste stream, which is a practice that continues today. *Recycling* rates dropped as waste production outstripped capacity for re-use and recycling under capitalist approaches that favour planned obsolescence.[6] Recycling went down from the levels in pre-industrial and early industrial times but was sparked again by the European concept of 'waste hierarchy' in the 1970s, which has steadily gained momentum under new concepts of resource scarcity and pollution overload impacts (Wilson, 2007). It is via this historical process that strategies for reduce, repair, reuse and recycle are developing into highly specialised knowledge areas.

The original idea of waste management using the *waste hierarchy* was born out of the Dutch government's shortage of landfill sites and was propelled forward by the environmental movement. It was first introduced in the European Union's Second Environment Action Programme in 1977. It is a model of waste management priorities based on the 'Ladder of Lansink' and involves a hierarchy of waste management handling techniques moving from

[6] Planned obsolescence is a business strategy in which the obsolescence (the process of becoming obsolete – that is, unfashionable or no longer usable) of a product is planned and built into it from its conception (http://www.economist.com/node/13354332).

prevention, to reuse, reduction, recycling, energy recovery, treatment and finally landfill disposal. It sparked a transition from 'end-of-pipe' (EOP) to preventive thinking which emerged with a multitude of new concepts, terms and phrases, namely *pollution prevention, source reduction, clean or cleaner production, waste minimisation, waste reduction, toxic use reduction* etc. It replaced the old terms that focused on reaction and control instead of prevention (UN-Habitat, 2010; Wilson, 2007 and Wolsink, 2010). As noted in section 1.2.3, this expanded further into concepts of *sustainable consumption and production* under recent United Nations policy and guidelines after 1992 that brought the root cause of the problem to the fore, by attempting to change unsustainable patterns of production and consumption in society. The involvement of the UN in waste and environmental policy also introduced concepts of *international standards, and transboundary waste management* and a more holistic framing of waste management that should be based on four major waste-related programmes as a focus, namely:

- Minimising waste;
- Maximising environmentally sound waste reuse and recycling;
- Promoting environmentally sound waste disposal and treatment; and
- Extending waste service coverage (UN, 1992).

To reduce the generation of waste, the conference suggested the enhancement of knowledge and information, encouragement of industries and all generators of waste to treat, recycle, reuse and dispose of waste at the *source of generation*. Subsequent to this, via the Rio Earth Summit and the Rio+20 UN processes, the waste hierarchy as approach has been endorsed and developed further with a stronger economic potential focus which sees waste management as a *green economy opportunity*.

Overall, this history shows increased epistemic specialisation (ER+) of waste management concepts and knowledge as well as expansion of this specialised knowledge within the international landscape. New waste management concepts developed as the history unfolds from disposing into rivers to challenges of municipal dumps which led to enforcement of disposal laws. There was a move to public health issues repair and reuse due to scarcity of resources, expansion to waste collection and waste governance via disposal to dumpsites and landfill sites. Disasters of pollution arose which led to the emergence of toxic waste concepts and development of technical standards for managing aspects such as landfill gases. Integrated waste management which led to reuse, repair, recycle and the waste hierarchy came into being.

The impetus of population density in waste management is also evident. The higher the population density the higher the increase of waste management challenges. As noted above, also highlighted is the multi- *and interdisciplinary form of 'region' knowledge specialisation* which requires multiple contributions that can address complex waste management challenges in practice, in situ, as well as across national and international borders.

The following underlying principles using specialisation are evident. Though the history shows increased epistemic specialisation (ER+) of waste management concepts and knowledge as well as expansion of this specialised knowledge within the international landscape, the social relation is surfacing through the impact of the people in activities which gave rise to the new concepts. The new concepts besides engineering activities are also informed by the activities performed by people. Without the actions of the people, the new concepts would not have been born. Though the epistemic code (ER+/SR-) is emphasised through concepts, the social (knower) code (SR+/ER-) is also emphasised through human activities which are emanating through the development of history. The history is inclusive of both personal characteristics, dispositions, values of the people and specialised knowledge, skills, procedures and techniques. When both the epistemic relation and the social relation are emphasised, Maton (2004) said that the knowledge code is elite (SR+/ER+) meaning that both personal characteristics, dispositions, values of the people and specialised knowledge, skills, procedures and techniques. are integrated and emphasised.

4.4.3 Legitimate Waste Management Knowledge Specialisation in Developing Countries as Reflected in Research Papers

As noted above, waste management knowledge shows a pattern of increased specialisation over time. Of interest to this study, is whether developing countries have followed a similar pattern of knowledge specialisation in waste management. In Chapter 1 I provided a brief overview of waste management in Africa. Here I focus on the academic papers selected for analysis to see how they reflect waste management knowledge specialisation from a developing country perspective.

Wilson (2007) conducted research on the drivers of waste management in developed and developing countries. He discovered that the mechanisms of waste are similar but they improve and expand to become more specialised as countries develop. According to Morrisey and Browne (2004, cited by Marshall & Farahbakhsh, 2013, p. 992), waste management strategies prior to the year 2000 did not consider social aspects of waste management in developed

countries. Emphasis was mainly on economic and environmental aspects. Secondly, waste management was monopolised by engineering models which were used by waste management agencies. None considered involving all stakeholders namely, government officials, industry, formal private sector services, local communities and rag pickers.

Marshall and Farahbakhsh (2013) explored the drivers of the development of waste management in developing countries which builds on the work of Wilson (2007) who developed six categories of waste management development drivers in developed and developing countries. He noted that the main driver of waste management in developing countries is still *poor waste management practices* and *public health implications*, which he noted remain severely problematic in developing countries. Basic livelihoods and survival, with associated resource and technical constraints, as well as trade-offs in priorities, results in waste management not featuring strongly on the list of public concerns. Though public health is a strong driver in developing countries, the key priority is still getting waste out from underfoot. Environmental protection remains low on both political and public agendas, but Wilson (2007) noted that this was starting to change. He noted further that in developing countries, legislation includes closure and phasing out of *unregulated disposal* sites as a requirement, but that the *enforcement of the closures and phasing out processes* tend to be weak.

Wilson (2007) argued further that the *potential resource value of waste* is a main driver in developing countries for waste management, as informal recycling provides a *potential livelihood* for the urban poor. Many cities in low income countries experience the problems that were experienced by the high income countries in the 19th century, for example, high levels of urbanisation, degrading sanitary conditions, unprecedented levels of morbidity and mortality (Wilson, 2007).

Secondly, *cultural and social aspects* are identified as contributors to waste management problems and waste management responses in developing countries. The following were surfaced from a reading of the papers selected for analysis for this study:

- Increasing urbanisation;
- Socio-economic disparities;
- Inadequate provision of sanitary and environmental amenities;
- Social exclusion and inequalities relating to existing waste management practices;
- High levels of morbidity and health risk; and

- High levels of mortality linked to inadequate sanitation, waste disposal and water supply provision.

In developing countries there are searing inequalities, varying economic, cultural, socio-economic and political landscapes, governance, policy, institutional and responsibility issues. Konteh (2009) argued that international influences have created *technical and non-technical challenges* of immense *complexity* in developing countries. Urbanisation which has exploded with great speed is accompanied by unplanned growth and inadequate resourcing of services such as waste management. This has resulted in a number of extreme land-use planning and *infrastructural challenges* which have led to urban poverty as the city governments are unable to provide services to the residents. People stay in slums with appalling sanitary conditions. Waste amenities in low income settlements are neglected. The houses are densely packed, with no space for refuse containers, refuse burial, composting, and movement of vehicles for the collection which results in waste being *dumped* in open spaces, access roads, and in waterways. Waste clogs in drains which are creating breeding areas for dangerous insects like mosquitoes. Animals and waste pickers scatter the waste and unmanaged leachate results in *contaminated food, water, and serious environmental and health conditions*. This especially causes serious *health implications* for young children and the elderly and those who work unprotected as waste pickers or those who survive off dumps (Coffey & Coad, 2010; Tacoli, 2012).

Marshall and Farahbakhsh (2013) claimed that waste management in developing countries is also based and established on the behaviour patterns and underlying attitudes of the population, diversity in ethnic groups, their cultural and social aspects, for example, cooking and eating habits, local architecture and the diets of the groups. Wealthy groups discard durable items instead of repairing them and high literacy groups discard high volumes of paper. Informal recycling is carried out by waste pickers who value much of what might otherwise enter the waste stream. Waste collection and disposal are also influenced by *social aspects*. If large quantities of odour generating foods (for example, fish) are consumed, collection needs to be more frequent especially in warm climates. Some groups dispose in containers while others see the streets as places to dispose their waste; given that there are few other options available the main practice is to move household waste away from the household area to elsewhere (e.g. streets, open land or rivers).

While the above paints a general picture of waste management issues and associated concepts and approaches to waste management as found in developing countries which reflect a mix of

social concerns and technical concerns, these same countries have also been developing waste management policy to introduce improved waste management practices. Schubeler (1996) and Konteh (2009) cited by Marshall and Farahbakhsh (2013, p. 993) concurred that the greatest challenge in low income countries is "to strike the balance between policy, governance, institutional mechanisms and resource provision and allocation". In low income areas there is inadequate *formulation and implementation of realistic policies*. Civil unrest and political instability contributes to the problems of waste management in some countries, for example in countries like Guatemala, waste management project continuity problems arise because municipal workers are replaced during every change in government which results in abandonment of the work planned in the previous term. Social and political urgency take precedence and leave a very small budget to be utilised for waste management projects. Low income countries lack the appropriate governance institutions and structures such as public policy institutions found in high income countries. Local authorities base their decisions on the interests of political parties which hinder waste management projects for political reasons only. Government bodies maintain inflated workforces for political reasons which consume considerable funds. Petty and high profile corruption is also rampant in many countries which retards economic growth, hinders administration and undermines the interests and welfare of communities (Henry, Yongsheng & Jun, 2006, p. 97). Though legislation has been developed it does not function properly as laws are not well enforced (ibid.).

Weak institutions have also been identified as a major problem in emerging and developing countries, for example, the polluter pays concept is inappropriate and not working for many countries because of lack of enforcement. Coffy and Coad (2010) suggested that lack of enforcement of legal frameworks causes large waste generators to dump waste illegally. Data on waste generation is often unreliable. Waste management budgets always serve half of the population and lack of funds prevents capacity building and improvement of waste management capacities. Local authorities experience land price increases and as the land prices increase, it is difficult for them to secure landfill sites next to the urban centres. The distances between landfill sites and the urban centres raises the transport costs of waste. Government therefore needs to have institutional structures with clear roles and responsibilities of institutions and government bodies to avoid controversies and ineffectiveness thus making waste management systems politically unstable (ibid.).

Wilson (2007) commented that in the absence of strong political and cultural drivers, international financial and development institutions act as key drivers of waste management development in developing countries. He relayed what the developed countries do in the developing countries. They bring conventional techniques and approaches from industrial countries, for example, importing sophisticated vehicles and equipment for collection, treatment and disposal of waste. These become expensive and difficult to be maintained by developing countries. The approaches used by the international financial institutions are not always the ones most appropriate for developing countries. They tend to emphasise global concerns over local environmental health problems, even though they are seeking to address local issues. They often recommend techniques and equipment developed in their countries with extremely different social and economic conditions and different waste characteristics. Use of these exported technologies later becomes too expensive and difficult to maintain, and developing countries experience an *absence of technical expertise* with operational and management capacity to maintain them. Jha, Singh and Gupta (2011), Yousif and Scott (2007) and Schubeler (1996, p. 19) called for utilisation of waste management methods which are considered and tailored according to the individual needs of the communities concerned. They must be *appropriate to the particular circumstances and problems of the city and locality* employing the capacity of *all stakeholders* including households and communities requiring services, private sector enterprises, workers both formal and informal, and government agencies at local, regional and national level.

The current paradigm that is gaining increased support in developing countries is the concept of *integrated waste management* which is being widely accepted as it makes the shift away from landfilling as a technical and engineering centred response strategy to a wider range of waste management options along the waste hierarchy. It strives to strike a balance between the technical waste management dimensions of environmental effectiveness, social acceptability and social opportunities development (e.g. job creation) and economic affordability. According to the integrated waste management approach, waste management should be tailored according to specific community goals by incorporating stakeholders' perspectives and needs, local context and the optimal combination of available appropriate methods of prevention, reduction, recovery and disposal. This approach requires both types of knowledge and if considered from Bernstein's point of view on inter-disciplinary knowledge, an interdisciplinary 'region' based knowledge structure, and from Maton's point of view, a knowledge structure that involves both epistemic relations (ER) and social relations (SR) in a more balanced approach.

In developing country contexts, it is increasingly being recognised that if social priorities mentioned above are ignored, waste management is doomed to fail. It should be fully embraced by local authorities and the public sphere and should go beyond the traditional methods that require only engineering experts to outline and frame solutions. It should involve public participation and empowerment, decision-making transparency, networking, co-operation and collective action, communication and accessibility of information (Carabius, Winistoerfe & Stuecheli, 1999; Dijkema, Reuter & Verhoef, 2000; Henry et al., 2006; Marshall & Farahbakhsh, 2013).

Legitimate waste management knowledge specialisation in developing countries as reflected in research papers emphasises both the epistemic relation and the social relation. According to Maton (2004), when both epistemic relations and the social relation are emphasised, the code is elite (SR+/ER+).

4.4.4 Summative view on waste management knowledge production as analysed above

Overall, the research papers reviewed for this analysis show that the boundaries between waste management and other disciplines are weak and that waste management can be seen as an interdisciplinary knowledge 'region', which is developing various forms of specialist concepts and approaches as time goes on and as science, technology and engineering solutions develop, creating a strong epistemic relation (ER+).

Parallel to these developed the issues of scarce resources which gave birth to reusing, repairing and recycling. Though these were not regulated, relationships emerged between science and the humanities and between the environment and people, introducing a stronger multi-stakeholder approach to waste management and a stronger mix between epistemic relations (ER) and social relations (SR). Current paradigms that are promoted focus on inter-disciplinary, integrated approaches that are socially inclusive, coupled with the waste hierarchy framework which offers a wider range of waste management responses to the problem of unavailability of land to accommodate landfill sites and increased levels of waste production. Developing countries' contexts raises the need for giving attention to both technical and social dimensions of waste management. This interdisciplinary, integrated approach also strengthens the need for both propositional and procedural knowledge and including both strong epistemic and social relations in the knowledge field. As Bhaskar (1998) noted, as our practices lead to better knowledge of the world, they also lead to changes in the classification and structures of knowledge.

The review of the research papers has also brought forward the complexity of this multi- and interdisciplinary knowledge 'region' from a critical realist point of view, which is interested in emancipatory knowledge (Bhaskar, 1998). Besides the content knowledge boundaries, waste management knowledge involves many more boundaries that need to be blurred and crossed for waste management to be more equitable, socially just and highly effective in the world. These include crossing the waste management boundaries between rural and urban residences, poor and rich citizens, high income and low income group residential areas, waste pickers and waste dealers, street waste pickers and dump waste pickers who sell straight to the dealers, waste management performed by private and public institutions, waste management in developed and developing countries, high income and low income countries, and informed and uninformed citizens. The data shows that waste management across the world is influenced by these disparities. Boundaries between these categories need to be blurred and crossed, creating an additional challenge for waste management knowledge as it develops further. This points towards the need to strengthen the social relations of waste management knowledge in a context where the more technical and scientific aspects of waste management knowledge are also strongly applied and used. In the next section, I turn to an analysis of the waste management knowledge as structured in the two South African legal frameworks which, as argued in Chapter 3, also form part of the field of production

4.5 WASTE MANAGEMENT KNOWLEDGE REFLECTED IN SOUTH AFRICAN LEGAL FRAMEWORKS, INCLUDING THE ROLE OF LEGISLATORS AND POLICY MAKERS AND REGULATORS

4.5.1 Legitimate Waste Management Knowledge as identified in the policies selected for review

As reported in Chapter 2, the Rio Earth Summit in 1992 affirmed that environmentally sound management of waste was among the environmental issues of major concern in maintaining the quality of the Earth's environment. It commanded the conference to elaborate on strategies and measures to halt and reverse the effects of environmental degradation in order to promote sustainable and environmentally sound development in all countries. Agenda 21, the international agreement emerging from the Rio Earth Summit, suggested that governments and intergovernmental organisations across the world should ensure sufficient national, regional and international capacity to monitor waste trends, implement waste minimisation policies, and reduce production of waste destined for final disposal in landfills (UN, 1992). As South Africa

is a signatory to the Rio Earth Summit's Agenda 21 document, South Africa also had to develop legal frameworks to address the issue of waste management in the country.

In 1995, after the first democratic elections in South Africa, a Consultative National Environmental Policy Process (CONNEPP) was established. It produced a White Paper on Environmental Management in 1997. The main goal of this White Paper was to review existing legislation and identify key legislative priorities for environmental management. This resulted in the development of the National Environmental Management Act 107 of 1998 (NEMA) (South Africa. DEA, 1998) which gave birth to the NEMA: Waste Act No 59 of 2008 (South Africa. DEA, 2008).

The NEMA: Waste Act of 2008 builds on and extends the NEMA of 1998. The purpose of the Act was to reform the laws regulating waste management, protect the health and the environment by prevention of pollution and develop institutional arrangements for waste management. Subsequently, the Waste Management Strategy of 2011 was developed to facilitate the implementation of the Waste Act of 2008. These are therefore the two most substantive national waste policy documents and are used to further analyse knowledge in the field of production, as described in Chapter 3.

- ***Knowledge in the National Environmental Management: Waste Act No. 59 of 2008***

In analysing the knowledge in the NEMA: Waste Act, I further adapted the framework for analysis that was used in Table 4.1 to include the emphasis on institutional structures and management knowledge. I also used the concept of 'specialist knowledge' to incorporate both propositional and procedural knowledge. The analysis includes a focus on types of knowledge, what it entails and I include indicators of this type of knowledge from the data. The underlying principles using Maton's framework are also discussed.

Table 4.2: Types of knowledge as found in the National Environmental Management: Waste Act No. 59 of 2008

Type of knowledge	What it entails	Indicator from the data
TYPE 1 Specialist knowledge	Waste management and environmental knowledge inclusive of propositional knowledge, definitions, key concepts, processes and procedures in waste management and the waste hierarchy	*Key concepts:* Integrated waste management, waste hierarchy concepts, Waste management services e.g. collection, treatment, recycling and disposal of waste Waste treatment facilities- Any sites used to accumulate waste for the purpose of storage, recovery *Types of waste and their definitions*: e.g. Building and demolition waste waste minimisation

		Processes: e.g. treatment is process that is designed to minimise the environmental impact of waste by changing the physical properties of waste and destroying toxic components of waste Procedures for waste management licence applications Incineration – method or process to convert waste to gases and residues by means of oxidation
TYPE 2 Economic knowledge	Knowledge pertaining to how waste funds need to be utilised	Ensure that funds from waste services are used for waste management services Provide for tariffs to be imposed to provide for waste management infrastructure or facilities Waste under certain circumstances is a resource and offers economic opportunities
TYPE 2 Social knowledge	Clarifies the attitudes and behaviours people need to have towards waste and also ways in which the behaviours of people can be changed	*Purpose of the Act* – to protect the health of people and the environment by prevention of pollution and ecological degradation and for securing ecologically sustainable development The following are the factors that need to be taken into consideration by a licensing authority namely: pollution on the environment, health, social conditions, economic conditions and the cultural heritage Storage collection and transportation of waste by people – they need to make sure that harm to environment and health are prevented Persons need not dispose waste in a way that it is likely to cause pollution of the environment or harm the health and well-being of people
TYPE 2 Technical knowledge	Involves engineering and scientific issues on how waste is treated	Treatment – any method or technique or process that is designed to: • Change the physical, chemical or biological character or composition of waste • Remove, separate, concentrate or recover a hazardous or toxic component of waste
TYPE 2 Legal frameworks	To provide for national norms and standards for regulating the management of waste by all spheres of government	Need to fulfil the rights contained in section 24 of the Constitution Minister needs to develop norms and standards for National, Provincial and Municipalities (local government) Minister need to establish a waste management strategy Need to put in place measures/ legal frameworks that seek to reduce the amount of waste that is generated
TYPE 2 Institutional and planning management knowledge	Deals with issues of planning, reporting, compliance and enforcement, licensing and control of waste issues	Prepare integrated waste management plans Achieving integrated waste management reporting and planning To provide for institutional arrangements and planning matters Develop procedures on the reporting of the plans
Knowledge of waste management structures	Inclusive of roles and responsibilities and how functions are distributed among the staff	Designate officers responsible for co-ordinating matters at national, provincial and local government levels

As can be seen from Table 4.2 above, the following types and forms of knowledge have been identified as being promoted / contained in the National Environmental Management: Waste Act No. 59 of 2008, namely, specialist knowledge, economic knowledge, social knowledge, technical knowledge, legal frameworks, institutional and management knowledge, and knowledge of waste management structures. Specialist knowledge is comprised of environmental knowledge and waste management knowledge and reflects contemporary waste management concepts such as integrated waste management and the waste hierarchy. Similar types of waste management knowledge are reflected in the policy as those reported on by the researchers. The policy includes names and categories of waste, definitions of terms and processes of the waste hierarchy and procedures in waste management focussing on disposal methods and processes. Economic knowledge in the policy relates less to job creation and entrepreneurship and more to ways of securing fiscal resources for waste management and on how waste funds need to be utilised. Social knowledge clarifies the attitudes and behaviours people need to have towards waste and also ways in which the behaviours of people can be changed towards improved management of waste based on the waste hierarchy concepts. Technical knowledge deals with engineering and scientific issues focussing on how waste is treated and how it changes from one form to another e.g. from organic waste to compost and the removal of toxic elements in hazardous waste.

The final category used in this analysis is systemic institutional knowledge which is composed of management and knowledge of waste management structures. Management knowledge consists of knowledge of functional management in waste management. It addresses issues of planning and reporting, compliance and enforcement and of licensing and control of waste issues. The knowledge of structures in waste management involves the roles and responsibilities of the spheres of government as derived from the Constitution and follows the legally binding policy implementation frameworks which covers the distribution of work by the Minister to relevant officials at different tiers of government.

- ***Knowledge in the National Waste Management Strategy of 2011***

As noted above, the National Waste Management Strategy is a legislative requirement of the National Environmental Management: Waste Act No.59 of 2008. Its purpose is to facilitate implementation of the objectives of the Waste Act. It is divided into four sections, namely, 1) methodology of its development, goals and approach to implement it; 2) regulatory and economic instruments; 3) institutional mechanisms, roles and responsibilities; and 4)

coordination and review mechanisms. It sets plans and targets to address the numerous waste management challenges experienced in South Africa.

As with the previous policy document, I analysed the document using the categories as adapted from the initial analysis (see Table 4.2 above). The analysis is contained in Table 4.3 below.

Table 4.3: Types of knowledge as found in the National Environmental Management Waste Strategy of 2011

Type of knowledge	What it entails	Indicators from the data
TYPE 1 Specialised knowledge	Waste management and environmental knowledge inclusive of propositional knowledge, definitions, key concepts, processes and procedures in waste management and the waste hierarchy.	Key concepts: Sustainable Environmental Management and better managed waste is a key component of sustainable environmental management Priority WM activities in the strategy: waste storage, collections and transport Treatment, processing and disposal Reduction reuse and recovery Integrated waste management and the waste management hierarchy is the overall approach that informs waste management in SA today WM processes in this document Inclusive of the following processes: waste avoidance, reduction, reuse, recycling, recovery and treatment and disposal as last resort Results in reduced greenhouse gas emissions, climate and improved air quality, waste minimisation, diversion of waste from the landfill
TYPE 2 Economic knowledge	Deals with economic issues and Knowledge pertaining to how waste funds need to be utilised	Waste management suffers from under-pricing and lack of sound budgeting The cost of waste management is not fully appreciated by consumers and industry Few waste treatment options are available and so they are more expensive than the landfill costs Recycling makes meaningful contribution to job creation and the GDP There is need to grow the contribution of the waste sector to green economy Ensure sound budgeting and financial management for waste services
TYPE 2 Social knowledge	Clarifies the attitudes and behaviours people need to have towards waste and also ways in which people's behaviours can be changed	A growing population results in increased volumes of waste Waste management in municipalities is influenced by the diversity of social and ethnic groups contained in their local, cultural and social contexts Make people aware of waste management through education and awareness Ensure that people are aware of the impact of waste on their health
TYPE 2 Institutional, planning and management knowledge	Deals with issues of planning, reporting, compliance and enforcement, licensing and	Achieve integrated waste management planning There is lack of readily available information Submission of waste data is not obligatory and where available is often unreliable and contradictory for sound planning

	control of waste issues	
TYPE 2 Legal knowledge	Pertain to issues that address needs relating to waste management regulations, norms and standards	Government and government bodies need to develop policy and regulations that promote the waste hierarchy Establish effective compliance with and enforcement of the Waste Act Develop Norms and Standards of waste at National, Provincial and Local government for classification of waste types Establish baseline regulatory standards for managing waste
TYPE 2 Infrastructure issues	Challenges associated with waste infrastructure	A historical backlog of waste services especially for urban informal areas, tribal areas and rural formal areas. Absence of recycling infrastructure – which enables separation of waste at source and diversion/ division of waste streams, Too few adequate, compliant landfill and hazardous waste management facilities, which hinders healthy disposal of all waste streams There are a large number of landfills available but a significant number of these are unpermitted

As can be seen from Table 4.3 above, the following types of knowledge have been identified in the National Environmental Waste Management Strategy: specialist knowledge (which includes propositional and procedural knowledge), economic knowledge, social knowledge, planning and management knowledge, legal knowledge and knowledge on infrastructure issues. The indicators and examples from the data for each category show resonance with the Waste Act and with the research-based knowledge that was analysed, all of which point to confirming that waste management knowledge can be categorised as an inter-disciplinary 'region' as its knowledge is composed of diverse types of knowledge with origins in a range of different disciplines. Furthermore, legal frameworks are determinants that waste activities take place according to prescribed methods and procedures of doing things. Everyone can produce legitimate knowledge provided they comply with defined practices listed in the legal frameworks. Epistemic Relations (ER) and Social Relations (SR) are surfacing from the South African waste management legal frameworks but the epistemic relation or the knowledge code is emphasised. The findings from the legal frameworks therefore concur with those of the research. They demonstrate that the knowledge code/ epistemic relation to the object (ER+) specialises in legitimacy within the waste management legal frameworks and the SR- is weaker.

4.5.2 Legitimate Waste Management Knowledge and Knowers as Analysed from Interview and Survey Data with Policy Makers

In this section I provide a more detailed analysis of the views of the policy makers who responded to the questionnaire on what counts as legitimate waste management knowledge and

knowers. As argued above and in section 3.4.2 in Chapter 3, these officials play a key role in producing waste management knowledge in South Africa, hence I have included them in the Field of Production.

I begin with an analysis of Part 1 of the questionnaire that I administered to the officials (see section 3.4.2) which requests the biographical information of the officials inclusive of their qualifications, fields of study and information on how and why they work in the waste section of the department. I then move on to analysis of the second two questions of the questionnaire, where officials were requested to recommend content knowledge for inclusion in a waste management course at Level 2. From there, I analyse their responses to proposed actions, and a prioritisation of these from the perspective of good waste management. The underlying principles of waste management, as reflected in these policy makers' discourses, are interpreted using their responses. The different parts of the questionnaires are treated individually below.

Table 4.4 indicates how their responses to engagement in the field of waste management work are reflective of the ER-SR relations. Their responses are arranged according to whether they are related to specialised knowledge or people oriented or social related reasons.

Table 4.4: DEA officials' motivation to work in Waste Management section

ER+ /SR -	(SR+ / ER-)	
Desmond: "My interest in applying chemistry in WM, particularly hazardous waste influenced me."	**Eric**: "To raise environment and waste awareness to [amongst] the communities since WM is a serious challenge in our country."	**Shalo:** Availability of job opportunities
Khalo: "WM is one of the key careers within Environmental Management."	**Eric**: "It is because of my love for a clean and healthy environment."	**Sister A:** Opportunities in the field of WM
Tembi : "Started with an assignment on an environmental education course. Then I got interested and learnt more."	**Tshilo**: "I wanted to contribute to beautifying the country through development of policies."	**Khalo:** "It is very interesting and covers all sectors of the economy."
Sister A: "The science behind it fascinated me as I did not think of it as a scientific field."	**Tembi** : "I found it very interesting and there was need to share what I knew while I also learnt more about waste management."	

The responses above indicate why the officials above joined the waste management section of the Department of Environmental Affairs. The table shows that two of the officials (Desmond and Sister A) joined because of the science behind waste management while the second group (Eric and Tshilo) were concerned about clean environments which include aesthetic values in

the environment. Other motivating factors as decribed by Eric and Khalo are issues of interdisciplinarity. They found WM accommodating all sectors including the needs of the people. They were interested to share and build the capacity of the people so that they could deal with the impacts of waste in the environment.

Overall, Table 4.4 shows that amongst this group of respondents the social relation (SR+) to the subject is emphasised more than the epistemic relation to the object (ER-). Four of the officials joined the section for their love and appreciation of the environment and the health and well-being of people; they wanted to have an impact on the lives of the people by making communities aware. Their responses show elements of aesthetic values and beautification. The knower code/social relation (SR+/ER-) is emphasised more than the knowledge code/epistemic relation (ER-/SR+) in their responses.

In the second section of the questionnaire, the officials were requested to give examples of types and content knowledge they felt were critical to be included in the training interventions of people at NQF Level 2 who are working within the spheres of waste cleaning and picking. The information provided was analysed and organised into two categories reflecting knowledge principles with a stronger epistemic relation (ER+/SR-) and knowledge with a stronger social relation (SR+/ER-) as shown in Table 4.5 below.

Table 4.5: Knowledge that needs to be emphasised in waste management interventions at Level 2 (based on DEA officials' responses)

	Specialised knowledge/ Epistemic Relation ER+ / SR-		**Knowledge related to people's experiences/ Social Relations SR+/ ER-**
	Waste classification. Types of waste and categories of waste. Differences between the types of waste Business skills		Contribution of the waste sector to the green economy Economic benefits of proper waste management values of recycling Streams which fetch good prices
	Understanding of the whole cycle of waste from generation to management inclusive of the hierarchy from generation and minimising to disposal Implementation of the waste management hierarchy Waste collection and separation in households		Waste management awareness: People should know and be taught why they should not litter, about the benefits of better waste management, and the benefits of living in clean environments Hazardous waste can bring health impacts Health and safety issues
	Appropriate containments, storage, transport and disposal		Importance and value of waste and recycling
	Landfill operations		Roles and responsibilities of spheres of government especially the municipalities.
	Legislative requirements, waste regulations and legal obligations of municipalities		

	Roles and responsibilities of spheres of government especially the municipalities		

As can be seen from Table 4.5 above, both epistemic and social relations are emphasised as the basis of achievement at this level amongst these officials. These respondents recommended that workers be exposed to specialist knowledge in waste management (types, classification, categories and the waste hierarchy), legal frameworks (waste regulations and legal obligations of municipalities) and the roles and responsibilities of the spheres of government. In relation to social aspects, they recommended that they should be taught the values of living in and appreciating clean environments, impacts of waste on health and the environment, the values of waste for the green economy, the economic value of waste, and recycling and the roles and responsibilities of the spheres of government. In this table, the epistemic relation to the object ER+ as well as the social relation to the subject SR+ are identified or determined as the basis of achievement for the workers at Level 2. According to Maton (2004) when both codes are emphasised, the code is elite (ER+ SR+).

In the third section of the questionnaire, a Likert scale questionnaire was adopted from the study conducted by Carvalho (2010, p. 43) in design at the University of Sydney in Australia. The seven waste management specialists were given 11 items. From the given items they were required to specify how important the items were for one to be good at waste management. They were given a table with 'quite important', 'very important', 'not very important' and 'not important at all' and they were requested to tick the box relevant to their opinion. The responses of the officials were sorted and put into a table. Two officials of seven were disqualified as they did not respond to this part of the questionnaire. Only five officials responded to this area. The findings are therefore representative of their views only.

Table 4.6: Responses of DEA officials to the Part 3 of the questionnaire (Likert Scale)

Name	**Desmond**	**Eric**	**Khalo**	**Shalo**	**Tembi**	**Number of responses confirming item good for WM**
Skill	Quite important	Not very important	Very important	Quite important	Quite important	4
Techniques	Very important	Quite important	Quite important	Very important	Very important	5
Specialist knowledge	Quite important	Not very important	Quite important	Quite important	Quite important	4
WM-legislations	Quite important	Very important	Quite important	Very important	Very important	5
Natural-born Talent	Not very important	Not important at all	Not very important	Not important at all	Not very important	0
Taste	Not important at all	Not important at all	Not very important	Not important at all	Not sure	0
An ability to make judgements	Quite important	Not very important	Very important	Not very important	Very important	3
A love of it	Quite important	Very important	Very important	Not very important	Very important	4
A lot of practice	Quite important	Not very important	Very important	Quite important	Very important	4
Read a lot from books	Quite important	Not very important	Very important	Very important	Quite important	4
Learning from other people	Quite important	Quite important	Very important	Very important	Quite important	5

Table 4.6 shows that of the five respondents who completed the research questionnaire, all agreed that specialist knowledge, skills, techniques and waste management legislations are very important in waste management. They also agreed that research / obtaining information or reading a lot from books is very important for waste management which shows a strong ER+. All five officials who responded agreed that the love of working with waste is important for officials in waste management, and four of five officials agreed that work in waste management needs practice. They also agreed that the ability to learn from other people is very important in waste management and this shows a strong SR+ relation.

This as found in these five responses indicates that both specialist knowledge (ER+) and social knowledge (SR+) are important for one to be good in waste management. When both codes and relations are emphasised, the code is said to be elite (ER+ SR+).

This is further analysed below in Table 4.7.

Table 4.7: Analysis of the knowledge contained in the responses above

Terms emphasising epistemic relations	Number of people confirming that it is good for WM	Terms emphasising social relations	Number of people
Specialist knowledge	4	Natural-born talent	**0**
Techniques	5	Taste	**0**
Skill	4	An ability to make judgements	**3**
WM legislation	5	A love of it (waste management)	**4**
Read a lot from books	4	Learning from other people	**5**
A lot of practice	4	A lot of practice	**4**

In Table 4.7 the items were classified according to their basis of emphasis from specialist knowledge or dispositions / social aspects. The responses show that the officials who participated in this study clearly acknowledged and recommended that specialist knowledge is critical for one to be a good waste manager. They also recognised the importance of having a love of working with waste and enjoyment of being with and among people. Taken together, Tables 4.6 and 4.7 indicate that both the epistemic relation (ER+/ SR-) and the social relation are important and need to be emphasised in waste management, as reflected by these respondents.

Based on this analysis of waste management knowledge production and emphasis amongst a selection of those officials who are actively developing waste management policy and legislation, it is possible to suggest that the underlying principles guiding the field of waste management is an interdisciplinary knowledge "region" which is inclusive of both specialised knowledge or epistemic relations to the object and social relations to the subject which privilege both specialisation in epistemic relations and the social relations. This can be further tested with more official respondents.

4.6 CONCLUSION

This chapter is the first of the three chapters reporting the findings of the research. It answers the first two questions of the research which investigate the legitimate waste management structure of knowledge and the knower and their underlying principles at the level of production. This has been done through an analysis of research papers, legal frameworks and questionnaires which have been administered to policy makers from the Department of Environmental Affairs.

The specialists/ researchers who produce knowledge in the field concur that waste management as a module is hosted in the natural sciences. Specialists concur that the structure of waste management knowledge is hierarchical/vertical. Waste management has characteristics from a number of disciplines and thus can be considered multidisciplinary and emerges from a number of disciplines and is therefore interdisciplinary. The different disciplines it emanates from are highlighted in section 4.3. Bernstein's clarification describes waste management as an example of a region (not a singular) as it integrates and recontextualises knowledge as the theoretical basis of practice in occupations and professions (these are listed and discussed in sections 4.3 and 4.4).

As the research papers were analysed, different categories of waste management knowledge levels emerged. These categories are inclusive of historical waste management knowledge in developed countries and historical knowledge in developing countries which were all reflected in the research papers analysed as the data for the level of production. This was named 'historical' as it showed developments within the waste management interdisciplinary knowledge region and how it changes within specific contexts and within specific times. In all the categories mentioned above, it has been realised that waste management is a region and interdisciplinary and shows elements of both specialist knowledge and social related knowledge especially regarding strong public health risks. Although the underlying purpose of public health risks with strong social relations are highlighted, they are not reflected much in in the knowledge produced which carries an epistemic relation.

The history of waste management shows an increase of epistemic knowledge in the form of development of new concepts as the development of the region unfolds. Though the epistemic relations are expanding through the development of waste concepts and knowledge, the social

relation is surfacing through the impact of the people in activities which give rise to these new concepts.

In developing countries, waste management knowledge as reflected in research papers emphasises both the epistemic and the social relations (ER+/SR+). It has also been ascertained that the lack of inclusion and recognition of one of the two in waste management activities leads to chaos and failure. This performance is confirmed by Bhaskar (1998, p. 30) when he says "as our practices lead to better knowledge of the world, they lead to changes in the classification and structures of knowledge in fields. It became clear that the insulation of the boundaries between disciplines is disintegrating to the state of being blurred.

The findings from the legal frameworks concur with those of the research: they demonstrate that specialised knowledge or knowledge code/ epistemic relation to the object (ER+) specialises legitimacy within the waste management field and the knower code, the SR- is weaker. The responses from the policy makers emphasise an interdisciplinary, region, integrated waste management knowledge and approach. They describe waste management as accommodating a scientific, engineering and technical basis while also emphasising the impact of people. When defining the content to be emphasised in education and awareness, both specialisations surfaced as well as when the characteristic features good for waste management were defined; social and the specialist knowledge also featured. Both relations are evident in the waste management interdisciplinary knowledge region but in varying strengths. Maton (2014) asserted that one form of knowledge can be relatively stronger+ or weaker- depending on variation of their strengths and what is emphasised in the field. Different parts of the tools used to collect data provided different results and perspectives on which one acts as the basis of achievement. Overall, though waste management has been identified as an interdisciplinary, knowledge region, the underlying principles show that presently waste management emphasises the epistemic relations to the object more than the social and the personal experiences of actors at the level of production. Researchers are calling for a more integrated approach inclusive of the participation of both the social and specialist stakeholders which will recontextualise and integrate social and specialist knowledge more. The next chapter discusses and reports on how waste management knowledge from the level of production we have discussed in this chapter, is recontextualised and integrated into the waste management qualifications, programmes and documents at Level 2 of the National Qualification framework.

Chapter 5:

Recontextualisation of Waste Management Knowledge in Level 2 Qualifications, Skills Programmes and Training Documents

5.1 INTRODUCTION

This chapter reports on the recontextualisation of waste management knowledge from the level of production into waste management qualifications, programmes and documents at Level 2 of the National Qualifications Framework. It addresses the following question: *How is waste management knowledge from the field of production recontextualised in the waste management training qualifications, skills programmes, documents and manuals for worker training on NQF Level 2?*

As explained in Chapter 2, the recontextualising field is a section or part of Bernstein's pedagogic device, which is made up of the level of production, level of recontextualisation and the level of reproduction. The level of production is where knowledge is created and constructed; recontextualisation is when and where the knowledge or specialist discourses are selected, decoded, transformed and simplified (i.e. recontextualised) for use in other contexts (Bernstein, 1990). The sections, sub-sections and main activities of recontexualisation are explained at length in Chapter 2 (section 2). In this study, the main recontextualisation processes I analyse are those most relevant to the Level 2 Waste Management training of EPWP workers, which involves recontextualisation of knowledge into qualifications and unit standards, skills programmes, and providers' training materials.

5.2 RECONTEXTUALISATION OF WASTE MANAGEMENT KNOWLEDGE IN LEVEL 2 QUALIFICATIONS

As mentioned in Section 1.2.2.5 in Chapter 1, the workers in the EPWP waste management projects are trained using a waste management skills programme which has been developed from the qualification, Environmental Practices NQF Level 2, which was developed by the Environmental Science, Environmental Management and Waste Management Standards Generation Body. The qualification is quality assured by the Local Government and related Services Sector Education and Training Authority (LGSETA). Though there have been changes in the SETA-based qualifications in the past few years as the QCTO began its work

following the NQF review (see section 1.2.1), this qualification has not been affected. The qualification is still in use and was re-registered in 2015. The last date for the enrolment of learners in this qualification is 30 June 2019, which results in a last date for achievement of learners against this qualification being 20 June 2022 (SAQA website, 2015).

The Local Government SETA, in association with the Institute of Waste Management of Southern Africa, conducted research which indicated the need to provide waste management qualifications in Environmental Practices at NQF Level 2 to implement the South African Growth path strategy (LGSETA, 2011 - 2016). This research was supported by workplace skills planning in municipalities and the Environmental Sector Skills Plan, which shows that there are a large number of workers employed, especially in municipalities and in waste management collection companies that would benefit from this qualification (DEA, 2010). The Environmental Practice Level 2 qualification is informed by policies developed by the Department of Environmental Affairs (e.g. NEMA: Waste Management Act, 2008). The DEA, earlier known as the Department of Environment and Tourism, has regularly identified a need to have properly trained professionals in municipalities to provide a range of environmental practice services and facilities such as parks, recreational facilities, municipal roads, arts theatres, primary health care and waste management, to name a few. The DEA (2010) study showed that, at the time, there were approximately 30 000 workers employed at elementary occupation level in municipalities alone. The same study showed that very little use was being made of the Environmental Practices qualifications for training at this level (ibid.). Relevant to this study is the fact that the Department of Environmental Affairs EPWP programme is also promoting this mandate of the department and, as noted earlier in Chapter 1, it facilitates training only in the projects relevant to its projects and mandate funded by the department. The implementation and use of the Environmental Practices qualifications by LGSETA are governed by the LGSETA's Sector Skills Plans, which are regularly reviewed.

The 2014 Local Government Sector Skills Plan indicates that one of its key mandates is to respond to Section 152 (1) of the Constitution (South Africa, 1996) which states the objectives of local government as being:

- to provide democratic and accountable government for local communities;
- to ensure the provision of services to communities in a sustainable manner;
- to promote social and economic development;
- to promote a safe and healthy environment; and

- to encourage the involvement of communities and community organisations in the matters of local government (RSA, 1996, p. 47 (2)).

The training projects implemented by the Department of Environmental Affairs in the EPWP programme are related to the LGSETA's commitment to respond to environmental issues, as articulated in the LGSETA sector's skills plan (2016, p. 6) which states:

> Municipalities need to be committed to the concepts of smart cities, clean cities and green economy. Smart cities, which have six pillars inclusive of smart economy, smart people, smart living and smart environment. They need to participate in the South African commitment to lead the transition to a low carbon economy by incorporating elements of sustainability and green practices in their jobs.

Local government need to ensure "clean cities" by managing waste in such a way that employment and wealth are created.

This creates the policy mandate for the LGSETA's role in the knowledge recontextualisation process, which is reflected in the purpose of the NQF Level 2 Environmental Practices qualification (see section 5.2.1 below) and the associated unit standards that guide the EPWP skills programme development (see sections 5.2.2 and 5.2.3 below).

5.2.1 Purpose and Structure of the National Certificate: Environmental Practice (NQF Level 2 qualification

As noted above, the Environmental Practices qualification was developed to train and furnish workers in elementary occupations with knowledge, skills and values of environmental issues and environmental management practices. These include workers in waste management, natural resources and ecological systems, many of whom are employed in local government (hence the LGSETA's role in managing this qualification and its use). The **objectives** of the qualification are to assist workers to apply basic principles and tools of environmental practices to avoid, minimise and remedy negative environmental impacts and to equip learners with knowledge, skills and values to participate meaningfully in society and contribute towards developing sustainable communities.

The **rationale** for the qualification lies in the fact that South Africans need to manage and protect their country's natural resources and ecological systems, while simultaneously using its resources in a sustainable manner as outlined in the Constitution (South Africa, 1996). As a result, people working as members of social and workplace communities need to become aware of their responsibilities towards the environment and need to be empowered to make informed

decisions regarding their own activities and the impact those activities have on the environment.

Workers and members of social communities need to be supported to engage with the complexities and challenges of environmental change (e.g. waste management) to ensure that use of resources and development is socially, ecologically and economically sustainable.

This qualification is **applied** in a range of contexts, such as local government, public and private waste management enterprises, cultural or natural heritage sites, community projects, recycling and recovery of resources. In this study, this qualification is applied to waste management in municipalities as noted in Chapters 1 and 3.

This qualification is outcomes based, and uses the SAQA unit-standards-based approach, which involves accumulation of a range of outcomes-based unit standards towards a full qualification. It is comprised of core fundamentals and elective unit standards. The core consist of ten unit standards accounting for 77 credits, the fundamentals consist of ten unit standards accounting for 39 credits and the 23 elective unit standards offer a range of options in credit values. Fundamentals and core unit standards are compulsory and from the electives, a provider needs to select unit standards with a value of thirteen credits. Learners completing the qualification have to complete a minimum of 128 credits. The structure of the qualification as listed in the SAQA website is presented below in Table 5.1.

The core unit standards include a number of unit standards that develop generic work skills such as ‘communicate at work’, ‘collect and use information’, ‘keep the work area safe and productive’, ‘orient self in the workplace’, as well as unit standards that are oriented towards environmental management such as ‘apply environmental management tools to assess impacts’, ‘take action to address impacts on the environment’, ‘use tools and operate equipment in an environmentally responsible manner’ and ‘work with, use and care for materials and resources which can impact on health and the environment’. From a credit weighting perspective, 36 of the core credits are oriented towards acquisition of generic workplace skills, and 35 of the core credits are directly focussed on environmental management. Two of the core credits appear to have been ‘borrowed’ from an agricultural qualification as learners are expected to ‘monitor, collect and collate agricultural data’. The context of this agricultural data collection in the wider frame of the environmental practice qualification is not clear. My

thinking is that waste management beneficiaries are trained on these skills to apply them in data collection in waste management activities.

The fundamental unit standards mainly involve applied literacy and numeracy competences, with a unit standard focussing on HIV/AIDs awareness.

The elective unit standards offer a range of options for further applying environmental management practices to contexts such as agriculture, water quality management, conservation practice, alien invasive plant management, cultural heritage management and waste disposal and management. They also include unit standards that further develop generic workplace and community engagement skills such as 'apply study and learning techniques', 'collect and record data', 'demonstrate an ability to work with local communities', 'develop a learning plan and portfolio for assessment' and 'use a personal budget to manage money', with some overlap here between the electives and the core and fundamental unit standards.

Table 5.1: Unit Standards for National Certificate: Environmental Practice NQF 2
(http://regqs.saqa.org.za/viewqualification.phpid=49605; 2013/09/12)

	ID	UNIT STANDARD TITLE	PRE-2009 NQF LEVEL	NQF LEVEL	CREDITS
Core	119554	Apply environmental management tools to assess impacts	Level 2	NQF Level 02	5
Core	13217	Collect and use information	Level 2	NQF Level 02	5
Core	12461	Communicate at work	Level 2	NQF Level 02	5
Core	13220	Keep the work area safe and productive	Level 2	NQF Level 02	8
Core	116080	Monitor, collect and collate agricultural data	Level 2	NQF Level 02	2
Core	12036	Orientate self in the workplace	Level 2	NQF Level 02	6
Core	13258	Participate in work group activities	Level 2	NQF Level 02	4
Core	12483	Perform basic first aid	Level 2	NQF Level 02	4
Core	13221	Perform routine maintenance	Level 2	NQF Level 02	8
Core	119553	Take action to address impacts on the environment	Level 2	NQF Level 02	10
Core	119556	Use tools and operate equipment in an environmentally responsible manner	Level 2	NQF Level 02	10
Core	119558	Work with, use and care for materials and resources which can impact on health and the environment	Level 2	NQF Level 02	10
Fundamental	8963	Access and use information from texts	Level 2	NQF Level 02	5
Fundamental	9009	Apply basic knowledge of statistics and probability to influence the use of data and procedures in order to investigate life related problems	Level 2	NQF Level 02	3
Fundamental	7480	Demonstrate understanding of rational and irrational numbers and number systems	Level 2	NQF Level 02	3

Fundamental	9008	Identify, describe, compare, classify, explore shape and motion in 2-and 3-dimensional shapes in different contexts	Level 2	NQF Level 02	3
Fundamental	8962	Maintain and adapt oral communication	Level 2	NQF Level 02	5
Fundamental	12463	Understand and deal with HIV/AIDS	Level 2	NQF Level 02	3
Fundamental	8967	Use language and communication in occupational learning programmes	Level 2	NQF Level 02	5
Fundamental	7469	Use mathematics to investigate and monitor the financial aspects of personal and community life	Level 2	NQF Level 02	2
Fundamental	9007	Work with a range of patterns and functions and solve problems	Level 2	NQF Level 02	5
Fundamental	8964	Write for a defined context	Level 2	NQF Level 02	5
Elective	14784	Apply sampling theory and practice in the chemical industry	Level 2	NQF Level 02	5
Elective	13202	Apply study and learning techniques	Level 2	NQF Level 02	3
Elective	116121	Apply sustainable farming practices to conserve the ecological environment	Level 2	NQF Level 02	5
Elective	113818	Clean and maintain area of responsibility	Level 2	NQF Level 02	8
Elective	14051	Collect and record data	Level 2	NQF Level 02	3
Elective	8330	Combat problem plants	Level 2	NQF Level 02	3
Elective	12334	Conduct water process laboratory tests	Level 2	NQF Level 02	6
Elective	13679	Control and extinguish a fire in a conservation area	Level 2	NQF Level 02	3
Elective	12351	Demonstrate An Ability To Work With Local Communities	Level 2	NQF Level 02	7
Elective	12352	Demonstrate knowledge of the roles and responsibilities of a community committee	Level 2	NQF Level 02	4
Elective	12033	Demonstrate knowledge of water cycle, water and wastewater systems and processes	Level 2	NQF Level 02	5
Elective	12465	Develop a learning plan and a portfolio for assessment	Level 2	NQF Level 02	6
Elective	11818	Investigate work opportunities in order to make a personal career/employment decision	Level 2	NQF Level 02	2
Elective	8346	Manage cultural heritage resources in the field	Level 2	NQF Level 02	2
Elective	116077	Monitor water quality	Level 2	NQF Level 02	3
Elective	119557	Operate waste disposal facilities	Level 2	NQF Level 02	6
Elective	12484	Perform basic fire fighting	Level 2	NQF Level 02	4
Elective	8332	Perform conservation guardianship	Level 2	NQF Level 02	8
Elective	116064	Recognise and identify the basic functions of the ecological environment	Level 2	NQF Level 02	4
Elective	119555	Separate, handle, store, treat and transport waste	Level 2	NQF Level 02	9
Elective	8348	Understand Nature Conservation issues	Level 2	NQF Level 02	4
Elective	10718	Use a personal budget to manage own money	Level 2	NQF Level 02	3

5.2.2 The EPWP Working on Waste Skills programme developed using the above qualifications

The EPWP projects in DEA vary in duration from one year to three years. The short-term nature of the EPWP projects, as well as project activities implemented by participants, make it impossible for the workers to be trained in extended training interventions such as year-long learnerships (see section 1.2.2.5). For this reason, shorter skills programmes become the most widely used type of formal skills development intervention in the EPWP. This is because of the duration of the projects and the short-term nature of worker contracts, as discussed in section 1.2.2.5.

The EPWP Waste Management Skills Programme was developed by the training section of the Environmental Protection and Infrastructure section of the Department of Environmental Affairs. It is composed of six unit standards with 50 credits, drawn from the qualification above. The selected unit standards (see Table 5.2 below) take the needs of the projects discussed above into consideration, as well as the level of education of the workers in the project. Importantly for the recontextualisation discussion below, is that only those unit standards *relevant to practical skills development within waste management* were selected from the full qualification. The skills programme was registered and approved by the Local Government Sector Education and Training Authority (LGSETA). This skills programme was selected by the DEA for the EPWP Working on Waste Programme, because of its relevance to the EPWP project with the hope that it would assist workers to impSouth Africarove waste management practices via their participation in the EPWP Working on Waste projects.

Table 5.2: The Structure of the EPWP Waste Management Skills Programme – NQF 2

SAQA ID	Unit Standard Title	Level	Credits
119555	Separate, handle, treat, and transport waste	2	9
119557	Operate waste disposal facilities	2	6
119556	Use tools and operate equipment in an environmentally responsible manner	2	10
119554	Apply environmental management tools to assess impacts	2	5
119558	Work with, use, and care for materials and resources, which can affect health and the environment	2	10
119553	Take action to address impacts on the environment.	2	10
	Total		50

(South Africa. DEA, 2013c)

To provide this training, the department makes use of accredited training providers who are listed on their database. The training providers use their own materials, which are endorsed by the LGSETA as per the prescripts of the Department of Higher Education and Training. According to the rules of the Department of Higher Education, the providers are not legally allowed to offer a programme if they are not accredited for that programme by a professional body or an Education and Training Quality Assurance institution (in this case, this would be the LGSETA). Students cannot qualify in the programme if the provider is not accredited. To be accredited, training providers have to develop programmes, which are aligned to the unit standards for which they obtain accreditation. Not only must the providers be accredited to run specific training courses, but the programmes they run should also be accredited as the accreditation involves both *institution and programme accreditation*. Programme accreditation is granted if the programmes, materials and assessment practices are adequately aligned with the unit standards, producing a relatively tightly inscribed recontextualisation regime (SAQA, 2015, p. 5). In this sense, providers have little freedom to 'veer off' from the directives of the unit standards, and the composition of the unit standard inscriptions within the approved skills programme. For the EPWP Working on Waste training, according to the regulated regime noted above, therefore one could expect there to be a tight alignment between the skills programme outlined in Table 5.2, and the training on offer to the workers.

To analyse the recontextualisation of the qualifications, the above legislative framing and monitoring of the recontextualisation process is important to note, as providers stand to lose their accredited status if they fail to adhere to the inscriptions of the Unit Standards or Skills Programmes, which combine a number of unit standards as, noted in Table 5.2. In many ways this represents a strongly 'top down' system for curriculum development and adheres to the 'design down' philosophy of outcomes-based education (Jorgensen, 2004). Influencing my analysis work was also the choice of focus and scope of analysis. As shown in Table 5.1 above, the qualification at Level 2 is composed of a minimum of 128 credits each consisting of about six to seven outcomes. My focus, however, is the EPWP Skills Programme, and initially I envisaged that I would focus on the knowledge recontextualisation of all six unit standards worth 50 credits as outlined in Table 5.2 above. This would involve investigating the recontextualisation of those six unit standards and 50 credits of training in accredited providers training materials to consider how the unit standards are reproduced in pedagogical contexts. After initial review of the scope of this, it appeared that this would be too broad and complex to analyse, and I therefore focussed on recontextualisation of knowledge from the qualification,

to the skills programmes and training materials with emphasis on Unit Standard 119555 which focusses on *'Separate, handle, treat, and transport waste'*. This is the main unit standard containing specific knowledge of waste management in the Skills Programme. The full detail of the Unit Standard is contained in Appendix 11. In the next section I provide more insight into the knowledge dimensions of the Unit Standard.

5.2.3 The knowledge requirements of Unit Standard 119555: 'Separate, handle, treat and transport waste'

In section 5.3 below, the learning materials of two providers recontexualised from Unit Standard 119555 are analysed. This is a nine credit Unit Standard, requiring approximately 90 hours of learning. Here I provide an outline of the unit standard and its knowledge-based prescriptions to make more visible the way the knowledge is recontextualised via the training.

As noted above, Unit Standard 11955 is a critically important unit standard for the EPWP Working on Waste skills programme. The knowledge of this Unit Standard is relevant to the activities of the projects discussed above (see also section 1.2.3.3). The main activities of the projects include separation, handling, storage, treatment and transport of waste, which are overarched by the waste hierarchy described in Chapter 2. This Unit Standard has five specific outcomes, and the knowledge associated with these specific outcomes is further differentiated via 1) a discourse of 'outcome range' which provides the scope of the expected specific outcome, 2) assessment criteria which specify what needs to be assessed, and includes an assessment criterion range which indicates the scope of what needs to be assessed, and 3) a section 'Essential Embedded Knowledge' which further specifies the knowledge that is expected to be evident via the assessment procedures. *Important for a recontextualisation analysis is to note that together these features give direction to the content and the activities of the learning materials and associated pedagogical practices. It is in interpreting these features of the unit standard into fields of actual pedagogy and practice where the training providers have 'freedom' of educational innovation and design (i.e. recontextualisation powers).*

The five specific outcomes are:

- Separate, treat and store waste;
- Transport waste;
- Control access, and monitor the flow of incoming materials to a waste facility;
- Recognise and report threats or damage to health, safety or the environment; and
- Compile relevant records.

I summarise the purpose, as well as the 1) outcome range, 2) assessment criteria and assessment criteria range for each of the above specific outcomes, as well as 3) the essential embedded knowledge that is relevant to all of the specific outcomes in Table 5.3 below, to allow for ease of access to the prescriptions of the Unit Standard.

Table 5.3: Specifications of Unit Standard 119555

UNIT STANDARD 119555: 'Separate, handle, treat and transport waste'			
PURPOSE: Ability to 'perform effectively' in the waste management field via ability . 1. Classify, separate, treat, store and transport waste safely, responsibly and in compliance with legislation) 2. Control and monitor access to a waste handling facility (i.e. PRACTICE KNOWLEDGE AND EXPERIENCE). Effective 'performance' in the waste management field will also require knowledge and understanding of: 1) Principles and concepts related to waste management and their application in practice 2) Methods of handling and transporting waste (i.e. KNOWLEDGE RELEVANT TO PRACTICES).			
Specific Outcome (SO)	**Outcome Range (OR)**	**Assessment Criteria (AC)**	**Assessment Criteria Range (ACR)**
SO 1: Separate, treat and store waste	Includes handling and treatment methods for water, effluent, waste, solids and gas. Treatment includes shredding, chopping, baling, compacting, neutralising, blending, incinerating, densifying etc. ***Note:*** *All SOs are further specified using ORs.*	**AC1:** Waste is separated into various categories and processed appropriately. **AC 2:** Handling treatment and storage methods are selected and applied for each category of waste correctly. **AC 3:** Work is carried out safely and with due care for self, fellow workers, equipment, materials and the environment. **AC 4:** Environmentally damaging practices are recognised and reported timeously and accurately. **AC 5:** Incidents and problems related to waste handling storage and treatment are discussed and explained appropriately and accurately.	**ACR 1:** Various categories: general, hazardous, biodegradable, recoverable, etc. **ACR 3:** Safely: correct techniques and procedures are used to handle waste; safe working practices are applied, appropriate protective clothing and equipment is used. **ACR 5:** Incidents and problems: includes impact of hazardous waste on the environment. ***Note:*** *not all ACs are further specified with ACRs*
SO 2: Transport waste	Transport refers to onsite movement of waste.	**AC 1**: Waste is loaded, moved, off-loaded and positioned efficiently and as required. **AC 2**: Operations are carried out to quality standards efficiently and safely. **AC 3:** Work is carried out safely and with due care for self, fellow workers, equipment, materials and the environment. **AC 4:** Incidents and problems are reported timeously and appropriate action is taken.	**ACR 2:** Operations include securing and releasing load, placing load correctly. **ACR 3:** Safely: correct techniques and procedures are used to transport waste; safe working practices are applied, appropriate

			protective clothing and equipment is used. **ACR 4:** Incidents and problems could include non-compliance with legislation and site or equipment requirements; inappropriate waste; hazardous conditions.
SO 3: Control access, and monitor the flow of incoming materials to a waste facility.	Incoming materials include waste, consumables and equipment.	**AC 1:** Materials are allowed to enter the site in accordance with organisational procedures. **AC 2:** Non- compliant waste recognised and appropriate action is taken. **AC 3**: Security of the facility, equipment and resources is maintained appropriately.	**ACR 3:** Includes recognising and reporting potential and/or actual breaches of security, accounting for consumables used and storing or immobilising equipment and resources.
SO 4: Recognise and report threats or damage to health, safety or the environment	This outcome includes an awareness of appropriate preventive, corrective or remedial actions.	**AC 1:** Potential dangers to health, safety and the environment which can arise during the processes of handling, separating, treating, storing and transporting waste are identified and described accurately and appropriately. **AC 2:** Measures which can be taken to prevent, correct or remedy threats or damage to health, safety or the environment are explained correctly.	
SO 5: Compile relevant records	Includes incident reports, operational records, maintaining confidentiality of information (organisational and client).	**AC 1:** Records are completed accurately, up to date and processed correctly.	

In addition to the above specifications related to the specific outcomes and their assessment criteria, the following 'essential embedded knowledge' (**EEK**) is also specified as 'the type of knowledge' that will be assessed:

UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE

The following items reflect the type of knowledge that the assessor will evaluate
Names and functions of:

- Types of waste
- Handling and treatment methods
- Terminology related to the waste stream

Purpose of:

- Separating and treating waste
- Inspecting containers and equipment
- Using personal protective clothing and equipment

- Standard operating procedures

Attributes, descriptions, characteristics & properties:
- Properties of the various types of waste
  methods of storing, treating and transporting waste
- Characteristics of equipment and materials used in waste handling processes
- Records required
- Personal protective equipment

Processes and events:
- Chemical, physical and biological methods of treating waste

Causes and effects, implications of:
- Effects of chemical and physical properties of waste on equipment, health and the environment
- Benefits and disadvantages of treatment methods
- Not following correct operational procedures

Procedures and techniques:
- Monitoring in-coming waste
- Separating, treating, storing and transporting waste
- Inspecting containers
- Responding to environmental threats
- Dealing with inappropriate waste
- Recording and reporting
- Dealing with emergencies

Sensory cues:
- Related to recognising potential and actual threats or damage to the environment
- Related to anticipating and responding to conditions that could interfere with safe and efficient operations
- Related to maintaining security

Regulations, legislation, agreements, policies, standards:
- Related to handling, storing, treating and transporting waste
- Related to the site / organisation
- Related to controlling access to the site
- Related to health and safety

Theory: rules, principles, laws:
- Science and technology related to handling, storing, treating and transporting waste
- Optimal payload
- Relevant principles of waste management

Categories:
- Types of waste

Relationships, systems:
- Relationships between the characteristics of the waste and the methods of treatment, storage and transport used

Source: Unit Standard 119555 (http//regqs.saqa.org.za/showUnit standard.php?id= 119555), see Appendix 11.

As noted above, this unit standard is the main referent for designing the training for Level 2 workers in the EPWP. Training providers use these specifications as outlined in the Unit Standard to construct the curricula involving the design of the learning programmes, their

materials and the assessment activities that are used in the training. In Tables 5.4 and 5.5 below, I analyse the knowledge contained in the Unit Standard specifications (outlined in Table 5.3 above). I use the categories of propositional, procedural, technical and legal (see Chapter 4) to capture the types of knowledge planned for in Unit Standard 119555. I also include expected values / social dimensions as well as expectations for planning and management. I differentiate the analysis of the knowledge that is included and is *explicit* in the specific outcomes and assessment criteria (Table 5.4), and the essential embedded knowledge which a category of knowledge that is less explicit, but is *implied or expected to be in place* for the outcomes to be achieved, and it is said in the unit standard that this knowledge will be included in the assessment (Table 5.5).

Table 5.4: The knowledge planned for in Unit Standard 119555 as reflected in the purpose, specific outcomes, outcomes range, assessment criteria and assessment criteria range (refer to Table 5.3 above)

PURPOSE: Specialised knowledge, procedures, skills and processes				Values/social	Planning & management
Propositional	Procedural	Technical	Legal	Values	Planning & management
Need to know and understand principles and concepts related to waste management and their application in practice. These include: Different types of waste (categories) Waste handling methods for different types of waste Treatment methods for different types of waste Environmental health and safety knowledge and knowledge of hazardous conditions Knowledge of appropriate equipment and knowledge of legal frameworks	Need to have an ability to classify separate, treat and transport waste safely, responsibly and in compliance with legislation Knowledge of reporting procedures Knowledge of health and safety procedures Knowledge of environmentally damaging procedures and practices Organisation procedures Control, access and monitoring of waste flows Knowledge of techniques and procedures to handle waste	Science and technology related to handling, storing, treating and transporting of waste Environmental and health protection measures and equipment use Quality standards knowledge Incident management knowledge	Classify separate, treat and transport waste safely, responsibly and in compliance with legislation Knowledge of environmental legislation relevant to waste management Compliance and non-compliance knowledge Knowledge of compliance legislative frameworks	Caring for the environment and health of the population, and safety of the people. Care for own health and safety Environmental damage reduction and/or avoidance Respecting compliance / legislative frameworks.	Reporting: Report threats, damage to health, safety or the environment Incidents and problems related to waste handling, storage and treatment

Table 5.5: The knowledge planned for in Unit Standard 119555 as reflected in the essential embedded knowledge specifications

ESSENTIAL EMBEDDED KNOWLEDGE- reflects the type of knowledge that the assessor will evaluate					
Propositional	Procedural	Technical	Legal	Values	Planning & management
Names and functions of : Types of waste Handling and treatment methods Terminology related to the waste stream *Attributes, descriptions, characteristics and properties of:* • Various types of waste (categories) • Methods of storing, transporting and treating waste • Characteristics of equipment and materials used in WM • Records required • Personal protective equipment Chemical, physical and biological principles (implied scientific knowledge) influencing waste processes and events. Knowledge of *causes and effects* including: Effects of chemical and physical properties of waste on equipment, health and the environment	Knowledge of *processes and events* Chemical, physical, biological methods of treating waste Knowledge of *procedures relevant to*: • Monitoring in-coming waste • Separating, treating, storing and transporting waste • Inspecting containers • Responding to threats • Dealing with inappropriate waste *(this assumes differentiation between appropriate and inappropriate waste)* • *Recording and reporting* Knowledge of *relationships and systems*, between the characteristics of waste and the methods of treatment, storage and transport used	*Theory: Rules, Principles* of: • Science and technology related to handling, storing, treating and transporting of waste. • Optimal payload • Principles of waste management Knowledge of *causes and effects* of: • Benefits and disadvantages of treatment methods • Operational procedures Knowledge of *techniques* related to: • Monitoring incoming waste • Separating, treating, storing and transporting waste • Inspecting containers • Responding to threats • Dealing with inappropriate waste *(this assumes differentiation between appropriate and inappropriate waste)*	*Regulations, legislation, agreements, policies* related to: • Handling, storing, treating and transporting waste • the site / organisation • controlling access to the site • health and safety	Understanding the *purpose* of practices such as: • Separating and treating waste • Using personal and protective clothing • Inspecting containers and equipment • Standard operating procedures	Recording and reporting, dealing with emergencies *Interpreting and using standards* related to: • the site / organisation • controlling access to the site • health and safety *Sensory cues related to:* Recognising potential and actual threats or damage to the environment Anticipating and responding to conditions that could interfere with save and efficient operations • Maintaining security

The knowledge that is more explicit in the specific outcomes and assessment standards of Unit Standard 119555 outlined in Table 5.3 and the essential embedded knowledge implied and expected to be achieved via the Unit Standard outlined in Table 5.4 shows that knowledge within the Unit Standard is inclusive of propositional knowledge, procedural knowledge, technical knowledge, legal and planning and management knowledge. From this, it is possible to see that it is *a combination of* propositional knowledge, procedural, technical and legal knowledge that structures and shape waste management specialised knowledge at this level. The above analysis in Table 5.3 and Table 5.4 also shows that there is greater specification of the knowledge in the essential embedded knowledge component of the Unit Standard. In particular, the types of knowledge are more clearly specified, for example, the essential embedded knowledge descriptions differentiates:

- names and functions (i.e. knowledge of categories);
- knowledge of principles;
- underlying scientific knowledge;
- knowledge of causes and effects;
- knowledge of systems and relations;
- knowledge of processes and events;
- knowledge of procedures;
- knowledge of techniques;
- knowledge of cause and effect;
- knowledge of theories, rules, policies, regulations, strategies, laws;
- organisational and site specific knowledge;
- knowledge of purposes; and
- Sensory knowledge practices.

This presents a challenging knowledge framework for Level 2 waste management learning, but also shows the integrated and interdisciplinary nature of waste management knowledge, reported on in Chapters 3 and 4. Before considering how this knowledge is contextualised into the actual training programmes, I firstly comment on what this knowledge framework reflects in terms of recontextualisation from the field of production, into the official recontextualisng field where waste management knowledge has been structured into Unit Standards at Level 2. I do this by comparing the knowledge represented in the Unit Standard (outlined in Tables 5.3, 5.4 and 5.5 above) with the findings reported in Chapter 4 where I analysed the knowledge being produced in the field of production.

5.2.4 Recontextualisation of the waste management knowledge in Unit Standard 119555 from the Field of Production

As reported in Chapter 4, waste management knowledge is produced by scientists, but also by the policy units in the DEA responsible for waste management. This knowledge is then recontextualised into waste management qualifications by the South African Qualifications Authority and its structures, which use the Unit Standards framework for this task, as reported on above. This, as discussed in Chapter 2, represents a recontextualisation process from the field of production to the official recontextualising field, following the work of Bernstein (1990).

The qualification was designed under a South African Qualifications Authority structure, named a Standards Generating Body (SGB). The SGBs were constituted of key education and training field specialists and major interest groups and national stakeholders who have an interest and credibility in the qualifications (Isaacs, 2000, p. 12). Thus, developers of this qualification (that is members of the SGB) were inclusive of specialists in the waste management field in partnership with members from the Department of Environmental Affairs and the Institute of Waste Management, an organisation leading waste management issues in the country. The skills programme reported on above, which draws on the Unit Standards from this Environmental Practice qualification, has been developed by the Department of Environmental Affairs for its EPWP programme needs. Overall, this shows a strong influence of specialist departments and sub-agencies of the state in the development and design of waste management qualifications and skills programmes, reflecting a top-down, policy-led process involving waste management knowledge producers. The qualification has mainly been developed by managing organisations in the field with minimal inclusion of the participants at the level of training.

The agenda of the recontextualising agents in the official recontextualising field is clear in the purpose and objectives of the qualification as being strongly focussed on relocating the knowledge developed in policy and legislative frameworks into qualifications, thus influencing curriculum from a top-down orientation. This can be seen in the objectives of the qualification and the purpose and knowledge inscriptions of the unit standard 119555 outlined in Tables 5.3 and 5.4.

In Table 5.6 below, I consider the extent to which Unit Standard 119555 reflects a ***delocation and relocation*** of the knowledge from the level of production (which was characterised by a

strong epistemic relation SR+) into the qualification that frames the EPWP Waste Management Skills Framework. I draw on the analysis in Tables 5.3 and 5.4 above capturing the details of the explicit knowledge stated in the specific outcomes and assessment criteria and the essential embedded knowledge. I compare this with the knowledge identified at the level of production from research papers and legislation in Chapter 4, Tables 4.1, 4.2 and 4.3. I use the objectives outlined above to organise the table. I use Bernstein's notion of strong or weak framing (F+ / F-) to comment on the strength of the alignment between the knowledge in the Unit Standard and the Field of Production. When the control of the selection of knowledge and design of the qualification is on the side of the specialists/managers/the Field of Production, it is declared that the framing in this design is strong (F+) and when it is more weakly aligned it is declared that the framing in this design is weak (F-).

Table 5.6: Comparison of the knowledge identified in the Field of Production, with the knowledge recontextualised into Unit Standard 119555 in the Official Recontextualising Field

Types of knowledge (as identified in Tables 4.1-4.2 and Tables 5.3 & 5.4)	**Knowledge in Unit Standard 119555 in the Official Recontextualising Field** (using the objectives outlined above, and summatively drawing on further detail from Table 5.3 & 5.4 above)	**Knowledge specified via scientific and policy related knowledge production in the Level of Production:** (summatively drawn from Tables 4.1, 4.2 and 4.3)	**Comment on the knowledge recontextualisation via comparison**
Propositional knowledge	Need to know and understand principles and concepts related to waste management and their application in practice	Definition of waste Waste and environmental knowledge Types and names of waste Categories of waste Concepts of waste Processes and procedures in waste management especially treatment methods Knowledge of the waste hierarchy Deeper levels of concepts in waste, including chemical, physical and scientific knowledge relevant to differentiate substances and treatment methods	There appears to be a strong framing (F+) between the *type of knowledge* expected in the Unit Standard at a broad level, and the knowledge produced in the field of production (i.e. propositional knowledge is emphasised in both). But as can be seen below, there is less *specification of the knowledge in the detail of the Unit Standard. It appears as if the Unit Standard will require the training provider to provide the specifications related to the different dimensions of propositional knowledge.*
Further specification for propositional knowledge	**Types of waste** (categories) are mentioned *but none are specified* **Concepts of waste** are mentioned, but not specified **Relationships and systems:** Relationships between the characteristics of waste and the methods of treatment, storage and transport used is specified, *but further detail in relation to how this applies to particular waste streams or types of waste are not specified.* Knowledge of : Waste handling methods for different types of waste	**Categories of Waste:** Organic / biodegradable, inorganic /non-biodegradable, inert, hazardous, plastic, glass, domestic and household, industrial **Concepts of waste:** Waste, reduce, reuse, recycle, disposal, landfill Waste management, waste minimisation, waste hierarchy, waste disposal, waste services, waste generation and collection **Sustainable Environmental Management, Waste Hierarchy and Integrated Waste Management:** Waste management integral to sustainable environmental management IWM. Integrated waste management and the waste	**Categories of waste** are mentioned in the Unit Standard, but specific details of the categories are not provided. No categories or types of waste are specified. **Concepts of waste** are included in the Unit Standard, but the exact range of concepts needing to be acquired are not mentioned. There is no emphasis on the **waste hierarchy and integrated waste management** in the Unit Standard, but environmental safety is emphasised. There is no emphasis on **generators of waste** in the Unit Standard.

	Treatment methods for different types of waste Environmental health and safety knowledge and knowledge of hazardous conditions Knowledge of appropriate equipment and knowledge of legal frameworks **Purpose of practices** is emphasised with separation and treating waste, using personal and protective clothing, inspecting containers, standard operating procedures. **Waste handling and treatment methods** for different types of waste are mentioned *but not specified.* Only characteristics of equipment and materials used in waste management, records required and personal protective equipment relevant to waste-handling methods is specified. Knowledge **of hazardous conditions and associated safety procedures** is required, *but not specified.* Knowledge of **causes and effects** *including* effects of chemical and physical properties of waste on equipment, health and the environment (*here one type of cause and effect is specified*). **Chemical, physical and biological principles** influencing waste processes and events – *i.e. this implies scientific knowledge but the scientific knowledge and principles are not specified.*	management hierarchy is the overall approach that informs waste management in SA today. It is inclusive of the following: waste avoidance, reduction, reuse, recycling, recovery, treatment, and disposal as the last resort. **Generators of waste**: Retain supermarkets and shops; households; industries. ***Purpose of Waste Management*** - to protect the health of people and the environment by prevention of pollution and ecological degradation and for securing ecologically sustainable development including reduced greenhouse gas emissions, climate and improved air quality, waste minimisation, diversion of waste from landfill. **Treatment methods:** Purpose of treating waste Encapsulation and when encapsulation techniques are needed. Different methods of treatment including chemical, physical, thermal and biological. Chemical treatment: includes processes such as neutralisation, oxidation, reduction, precipitation and hydrolysis. Composting and what it entails and which waste stream it is best for (i.e. organic waste) Incineration and what it entails and which waste stream and which waste stream it is best for (i.e medical waste) Implied **chemical, physical and scientific knowledge** relevant to differentiate substances; and treatment methods relevant to different types of waste	**Relationships and systems** are mentioned in the Unit Standard, but are not specified. In the knowledge analysis, specific relationships and systems are mentioned, e.g. that different types of waste require different types of treatment (e.g. organic waste can be composted; medical waste must be incinerated). The range of treatment methods relevant to the different waste streams are not outlined in the Unit Standard. **Purpose** of waste management is emphasised in the Field of Production, while purposes of specific practices are emphasised in the Unit Standard. **Waste handling and treatment methods** are specified in more detail in the field of production, and more specification is provided on the types of treatment methods and when to use them. In the Unit Standard, equipment, materials, records and protection related to waste handling methods are specified, rather than knowledge of the different waste handling methods. In the Unit Standard, knowledge of causes and effects of chemical and physical properties of waste (implying knowledge of these) on equipment, health and the environment is required and specified as EEK in the Unit Standard but knowledge of cause and effect appears to be less specified in the Field of Production. In both the field of production and the ORF Unit Standards, the **underlying**

			physical, chemical and scientific knowledge relevant to differentiate waste types; substances; and treatment methods relevant to the different types of waste are *implied and are not specified, **BUT are assumed to be in place.***
Procedural knowledge	Need to have an ability to classify separate, treat and transport waste safely, responsibly and in compliance with legislation	Managing waste Minimising waste Maximising environmentally sound waste management through processes of reduction, reuse, recycling, waste disposal and treatment (IWM processes within a waste hierarchy and environmental sustainability frame)	There appears to be a strong framing (F+) between the *type of knowledge* expected in the Unit Standard at a broad level, and the knowledge produced in the field of production (i.e. procedural knowledge is emphasised in both). But as can be seen below, there is less *specification of the technical procedural knowledge in the detail of the Unit Standard, but the Unit Standard appears to cover a wider range of procedures and how they are situated in practice. Again (as above) the Unit Standard will require the training provider to provide the specifications related to the different dimensions of propositional knowledge and how these are situated in practice contexts at Level 2.*
Further specifications of procedural knowledge	Understand methods of handling and transporting waste Knowledge of procedures relevant to: *Monitoring of incoming waste, * Separating, treating and transporting waste * Inspecting containers, * Responding to threats, * Dealing with inappropriate waste Chemical, physical and biological methods of handling waste are noted, but *details of these are not specified*.	Different types of waste disposal and management methods are specified in the field of production including: **Waste reduction** to reduce production of waste for final disposal *(involving mainly engineering processing knowledge)* **Chemical disposal** includes processes and methods of neutralization, oxidation-reduction, precipitation and hydrolysis *(involves mainly chemical engineering knowledge)*	The emphasis in the Field of Production is on methods of waste disposal, not on methods of transporting waste. The Unit Standard emphasises both. In the Unit Standard **knowledge of procedures of waste management** are proposed in the sequence of managing waste (e.g. incoming waste, separating waste, inspection, dealing with problems etc), whereas in the field of production, the procedural knowledge specifies the

	Knowledge of a range of procedures is required including: • Waste management procedures, • Waste handling procedures, • Health and safety procedures, • Organisational procedures, • Environmentally damaging procedures and responses to these • Reporting procedures	**Physical disposal** includes the processes and methods of encapsulation and filtration *(chemical and physical sciences and engineering)* **Thermal methods** include processes of converting waste into non-hazardous form and reducing volumes, which allows opportunities for recovery of energy from waste *(engineering knowledge)*	types of procedures relevant to the different types of waste in more detail. The Field of Production provides more detailed process content related to the chemical, physical, biological and thermal methods of waste disposal than the Unit Standard. A wider range of procedures is required in the Unit Standard than are found in the Field of Production. None of the procedures are specified in detail in the Unit Standard.
Technical knowledge	Need to know science and technology related to handling, storing, treating and transporting of waste	Waste management processes or changes taking place at the level of waste generation Engineering and technological knowledge related to: • Separation and sorting at source • Waste minimisation • Reuse and recycling of waste • Waste treatment (One needs technological knowledge of which chemicals types of waste to separate/ sort from what, when and how).	There appears to be a strong framing (F+) between the *type of knowledge* expected in the Unit Standard at a broad level, and the knowledge produced in the field of production (i.e. technical knowledge is emphasised in both). But as can be seen below, there is less *specification of the scientific and technical procedural knowledge in the detail of the Unit Standard related to the methods of treatment. The Unit Standard expects a range of technical knowledge related to the core technical practices, covering a wider range of technical knowledge than is put forward in the field of production. Again (as above) the Unit Standard will require the training provider to provide the specifications related to the content related dimensions of the technical knowledge and how these are situated in practice contexts at Level 2.*

Further specifications of technical knowledge	Handling, treatment, storage methods are selected and applied in each category of waste correctly. Theory, principles and rules of: • Science and technology related to handling, sorting, storing, treating and transporting of waste • Optimal payload • Principles of waste management Causes and effects of: • Benefits and disadvantages of treatment methods • Operational procedures Knowledge of techniques related to monitoring, separating, sorting, treating, storing and transporting waste, inspecting containers, responding to threats, dealing with inappropriate waste Knowledge of environmental and health protection measures and equipment use Quality standards Incident management knowledge	**Definition of Treatment** – any method or technique or process that is designed to: • Change the physical, chemical or biological character or composition of waste • Remove, separate, concentrate or recover a hazardous or toxic component of waste Waste management processes or changes taking place at the level of waste generation • Separation and sorting at source • Waste minimisation • Reuse and recycling of waste *(One needs knowledge of what to separate/ sort from what, when and how i.e. technical application of engineering knowledge)* **Treatment Methods** involve both technical knowledge and practical skills used to convert waste into non-hazardous substances, involving *encapsulation* processes (named above) so that waste does not migrate and create environmental hazards when released into the environment. *Encapsulation* techniques are specialised according to type of wastes, and are necessary for inorganic wastes such as those containing toxic heavy metals. There are four different methods of treatment – chemical, physical, thermal and biological, each with their own specialist technical and practical approaches e.g. chemical processes included neutralisation, oxidation reduction, precipitation and hydrolysis. *Incineration:* Incinerators are in the form of open pits used to burn bandages and blood products. After burning, ash is moved straight to a landfill.	The Field of Production emphasises detail on the definition of treatment, which is not emphasised in the Unit Standard The field of production identifies four different methods of treatment – chemical, physical, thermal and biological, each with their own specialist technical and practical approaches e.g. Chemical processes included neutralisation, oxidation-reduction, precipitation and hydrolysis. None of these is specified in the Unit Standard, but learners are expected to know the 'science and technology' associated with these, as well as the benefits and disadvantages of these. The Unit Standard also expects technical knowledge of environmental and health protection, quality standards, incident management, optimal payload, and knowledge of technical aspects of monitoring incoming waste, inspection of containers, and dealing with problems.

Legal / legislative knowledge	Classify, separate, treat and transport waste safely, responsibly and in compliance with legislation	Policy shifts away from landfilling to integrated waste management using the waste hierarchy to structure legislation, norms and standards	There appears to be a strong framing (F+) between the *type of knowledge* expected in the Unit Standard at a broad level, and the knowledge produced in the field of production (i.e. legislative knowledge is emphasised in both). But as can be seen below, the Unit Standard emphasises legislative knowledge relevant to particular waste management practices, as well as organisational and health and safety legislative knowledge. *Again (as above) the Unit Standard will require the training provider to provide the specifications related to the content related dimensions of the legislative knowledge and how this is situated in practice contexts at Level 2.*
Further specification of legal knowledge	Knowledge of environmental legislation relevant to waste management. Compliance and non-compliance knowledge Knowledge of regulations, legislation, agreements and policies related to: • Handling, storing, treating and transporting waste • The site / organisation • Controlling access to the site • Health and safety	Need to fulfil the rights contained in section 24 of the Constitution White Paper on Integrated Pollution and Waste Management (2000) emphasises a shift from control to prevention. Measures/ legal frameworks that seek to reduce the amount of waste that is generated Norms and standards for National, Provincial and Municipalities (i.e. different levels of governance)	Exact specification of which legislation relevant to waste management compliance, or which regulations, legislation, agreements and policies are required to be learned at Level 2 are not provided in the Unit Standard, or in the Field of Production. The Unit Standard does not emphasise the policy shift reflected from landfilling to IWM. The Unit Standard however, specifies that regulations, legislation, agreements and policies related to handling, storing, treating and transporting waste should be covered, as well as regulations, legislation, agreements and policies relevant to the site / organisation; controlling access to the site; and workers' health and safety, offering an

			'organisational level' focus for legislative knowledge.
Planning and management knowledge	Reporting: Report threats, damage to health and safety or the environment, as well as incidents and problems related to waste handling, storage and treatment.	To provide for institutional arrangements, planning, co-ordination, health and safety and risk management.	At a broad level, there is strong alignment as both include planning and management knowledge (F+). However, as shown below, in the Field of Production, integrated waste management reporting and planning is emphasised, along with health and safety, while in the Unit Standard, practical skills and 'sensory cues' related to monitoring and controlling waste management flows, and health and safety measures are emphasised.
Further specification of planning / management knowledge	Compile records; control and monitor flow of incoming materials to a waste facility. Should know what a waste facility is and how it works Dealing with incidents and emergencies (health and safety of people and environment) Interpreting and using standards related to the site, controlling access to the site, health and safety; monitoring standards Using sensory cues related to recognition of potential and actual threats or damage to the environment or self; anticipate and respond to conditions that could interfere with safe and efficient operations; maintaining security	Achieving integrated waste management reporting and planning To provide for institutional arrangements and planning matters Develop procedures on the reporting of the plans Health and safety procedures and responses	The Field of Production emphasises integrated waste management reporting and planning, and institutional arrangements while the Unit Standard emphasises practical aspects of monitoring and reporting. The Field of Production emphasises the development of procedures and planning approaches, while the Unit Standard emphasises practical reporting and monitoring (not planning). It emphasises interpretation of standards, not development or co-development of standards at site level. The Unit Standard emphasises 'sensory cues' as a means of identifying, recognising and responding to incidents, threats and risks.
Social knowledge	Caring for the environment and health of the population and safety of the people.	Public awareness and attitudes towards waste impact on waste management systems from	At a broad level there is strong alignment between the Field of Production and the

		household storage to separation and waste reduction Includes values and attitudes developed through interactions in contexts and society	Unit Standard (F+) as both emphasise social knowledge. However, when one examines the detail of the social knowledge in the Unit Standard, there is weak framing as only a limited range of social concepts and processes are included (F-)
Further specifications of social knowledge	Care for self, fellow workers, equipment, materials and the environment Values are related to the purposes of waste management Respect for legislation and compliance is embedded in the Unit Standard	Waste is never going to disappear. Not as long as humans keep consuming materials, goods at the rate we do In some areas for example, waste collection is not seen as an honourable profession People should not dispose of waste negligently Persons should not dispose of waste in a way that it is likely to cause pollution of the environment or harm the health and well-being of people A growing population results in increased volumes of waste Waste management in municipalities is influenced by the diversity of social and ethnic groups contained in their local, cultural and social contexts In some cultures large quantities of odour generating foods (for example, fish) are consumed, and this influences the need for frequent collections Ensure that people are aware of the impact of waste on their health	The Field of Production emphasises moral dimensions of waste management, which include human and environmental concerns. It also emphasises cultural and contextual dimensions of waste management, as well as implied 'stigma' attached to waste management as a preferred profession. It further emphasises self-reflexivity to understand impact of waste on own health. The Unit Standard emphasises care for self, fellow workers, equipment, materials and the environment, respect for legislation, compliance, and values related to the purposes of waste management at a technical level. The Field of Production therefore offers a more nuanced set of social concepts for waste management that are inscribed in the Unit Standard. These are not merely morally or legislatively inscribed, but are also related to culture, diversity, context, social stigma and self-reflexivity.
Economic knowledge	Not included	Monetary issues and entrepreneurship issues applied to waste management. Job creation and social upliftment Entrepreneur development based on economic viability of waste management activity	The Unit Standard does not include a focus on economic knowledge related to waste. It is silent regarding waste as a resource and the fact that communities can be

			economic viable due to their recycling of waste. There is thus very weak framing in this area (F-) in the Unit Standard. This is also not included in the qualification as a whole, showing weak framing in this area (F-) overall for the Level 2 qualification.
Historical Knowledge	Not included	Emphasis on the shift from local and indigenous ways of waste management, to waste disposal into landfills and more recently towards a focus on the whole waste hierarchy, which includes reduction, re-use and recycling Environmental movements brought the waste disposal issue to the political agenda and regulations addressing water pollution and waste emerged	The Unit Standard does not include a focus on historical waste management knowledge, or changes in waste management practices over time; or the emerging social movement politics of waste management. There is thus very weak framing in this area (F-) in the Unit Standard. This is also not included in the qualification as a whole, showing weak framing in this area (F-) overall for the Level 2 qualification.

Table 5.6 above shows that at a broad level (i.e. at the level of the objectives and specific outcomes), the content knowledge of Unit Standard 119555 is largely composed of the key dimensions of knowledge contained in both the academic papers and the legal frameworks analysed and discussed in chapter 4 which were used to identify knowledge being produced in the Field of Production. This shows that the Unit Standard at a broad level of outcome and objectives statements mirrors the needs of the waste management specialists and leadership/ management in the waste management field in the country. In particular the Unit Standard includes a strong alignment with the following categories of knowledge found in the Field of Production: Propositional, Procedural, Technical, Legislative, Planning and Management, and Social. The analysis above shows that there is strong framing (F+) at the level of outcomes and objective statements for this Unit Standard with knowledge produced in the Field of Production. The recontextualisation in these documents at this level shows that the fields' leading agents are mediating the way knowledge is classified into the Unit Standards, especially at the level of the broad framing of the Unit Standards however it also emerged from the table that the detail of the knowledge in the unit standard is scanty and limited when compared with that in the field of Production. Though some of the issues and concepts are listed in the unit standard it seems as if they are leaving the detail out for the training providers to supply. There is no indication of a flow of knowledge from the side of the acquirers at this level. The researcher further explains this scenario by using Bernstein's framing and classification. When the control of the selection of knowledge and design of the qualification is on the side of the specialists / managers/ the level of production it is declared that the framing in this design is strong.

Table 5.7: Summary of the strength of the framing at a broad level of alignment of objectives, but also at the level of the specified content in the unit standard and the field of production (compared in Table 5.6 above)

Type of knowledge	Framing at a broad level of alignment of Unit Standard Objectives	Framing at the level of more specified content in the Unit Standard
Propositional knowledge	F+ (strong framing)	F-to-F- (in some areas there is specification alignment, but overall specification of knowledge is weaker) There is a strong framing in propositional knowledge between the unit standard and the Field of Production. Both include knowledge of the types, categories and concepts of waste. Include knowledge of handling methods, treatment methods and knowledge of issues of health and safety associated with how to handle the different types of waste. Relationships and systems are mentioned in both. In the unit standard equipment, materials records and protection related to waste handling are specified rather than the knowledge of the

		handling methods. In all these issues named above in the Unit Standard there seems to be lack of detail on the specifications of the knowledge. There is also a lack of a connection of the knowledge to the trends of development within the field (for example, waste hierarchy and integrated waste). It seems the details are left out for the training providers to bring them up in their materials, which displays that the knowledge is weaker in the unit standard.
Procedural Knowledge	F+ (strong framing)	F to F- (in some areas there is specification alignment, but overall specification of knowledge is weaker) There is a strong framing / alignment between the Field of Production and the Unit Standard. They both emphasise procedural knowledge but at different levels of complexity. The Unit Standard covers a wide spectrum of procedures, for example, monitoring of incoming waste, waste management procedures, waste handling etc as listed in Table 5.6. However, the Unit Standard has less detail on the specifications on that wide range of procedures. Sometimes, though the alignment is strong the points emphasised are different, for example, in the management of waste procedures, the unit standard emphasises methods of transporting waste, incoming waste, separating waste and inspections while the Field of Production provides more detail on content procedures of disposal related to chemical, physical biological and thermal methods. More detail still needs to be included in the Unit Standard.
Technical knowledge	F+ (strong framing)	F-to-F- (in some areas there is specification alignment, but overall specification of knowledge is weaker). There is strong framing (F+) between the type of knowledge expected in the Unit Standard and the knowledge produced at the Field of Production. Technical knowledge is mentioned in both but at the level of the Unit Standard there is less detail on the specifications of scientific and technical procedural knowledge. Though it is not specific, it expects and requires a range of technical knowledge related to the core waste management technical processes. This implies that the knowledge is weaker and therefore the Unit Standard requires the training provider to provide detailed knowledge specifications related to the content related dimensions of the technical knowledge.
Legislative knowledge	F+ (strong framing)	F-to-F- (in some areas there is specification alignment, but overall specification of knowledge is weaker between the Unit Standard and the Field of Production. The Unit Standard and the Field of Production both refer to the fact that all the processes need to be implemented taking the relevant legal frameworks into consideration, for example the Unit Standard indicates that the learners should have knowledge of legislations and policies related to handling and storing of waste. Unlike in the Field of Production, it does not emphasise the policy shifts shown in the shift of trends, for example, from landfilling to integrated waste. Moreso the Unit Standard does not specify the exact regulations, which are relevant to waste management at Level 2. The knowledge specifications are therefore weaker.
Planning and management knowledge	F+ (strong framing)	F to F- (in some areas there is specification aligned but the Unit Standard emphasises planning and management of knowledge, but overall specification of knowledge is weaker). There is a strong framing or alignment between the Unit Standard and the Field of Production. They both emphasise planning and reporting but the Unit Standard emphasises practical reporting and monitoring while the Field of Production emphasises the

		development of procedures and planning approaches. The knowledge around planning and reporting in the Unit Standard is limited and therefore classified as weaker.
Social knowledge	F+ (strong framing)	F to F- (in some areas there is specification alignment i.e. related to care of self and environment and respect for compliance and regulations, but overall specification of knowledge is weaker due to exclusion of knowledge from the Field of Production on cultural aspects, diversity, social movements etc. in the Unit Standard (i.e. politics of waste, and issues of stigma)
Economic knowledge	F- (very weak/not present)	F- (very weak/not present; significant in the Unit Standard and qualification is exclusion of knowledge on how to participate in the recycling/waste management economy)
Historical knowledge	F- (very weak/not present)	F- (very weak/not present; significant is exclusion in the Unit Standard and broader qualification of the changes in waste management practice from more traditional forms of waste management to IWM procedures which are quite technically and scientifically inscribed)

The analysis above in Table 5.7 also shows a weakening of framing when it comes to the specifications of the knowledge in the Unit Standard's details: outcome range; assessment criteria; assessment range and EEK (F to F-). Thus, here the acquirers and the providers of training on this qualification have some potential contributions to make, especially related to the specification of content as it relates to context and type of waste being managed, type of waste management site and level of operation. Overall, however, they have little control in the selection of types of knowledge in *the overall design* of these qualifications and *at a broad framing level their control and framing over this design is weak*. On the other hand, at the level of qualifications outcome and objectives design, it shows that the classification is strong (C+), and that the boundary between the knowledge produced in the Field of Production and everyday knowledge is insulated, at least at the level of qualification outcomes specification. There is little or no flow of waste management knowledge from the receivers of the training into the waste management discourse at the level of qualifications outcome and objectives design.

However, due to weak specification of knowledge in the Unit Standard contents (EEK, outcome range statements, assessment criteria and assessment criteria range statements) in relation to the specific knowledge being produced in the Field of Production, there is a weaker and sometimes inconsistent framing (F-) at the level of knowledge specification in the Unit Standard (as shown in Tables 5.5 and 5.6). This requires the training provider to provide for further specification and interpretation of the Unit Standard in the Professional Field of Recontextualisation as they design training programmes and materials from the Unit Standards. Ideally, it would require the training provider to have a deep understanding of knowledge in

the Field of Production and the capacity to recontextualise this to the Field of Reproduction in ways that compensate for weak or inconsistent specification of knowledge within the Unit Standard itself, in ways that also meet the regulatory requirements for unit standards accreditation.

Also of interest to this study is the absence of economic and historical knowledge in the Unit Standard (which represents a weak framing in qualification in relation to the Field of Production). Significant here is that empowerment strategies such as economic participation in the waste management industry, political strategies such as participation in social movements for waste management and cultural experience and knowledge of waste management are excluded from the EPWP endorsed learning outcomes and the design later in the thesis as I probe the engagement with workers' learning and programme design. I turn now to an analysis of the way in which training providers have recontextusalised Unit Standard 119555 into their training programmes.

5.3 RECONTEXTUALISATION OF KNOWLEDGE FROM UNIT STANDARD 119555 BY TRAINING PROVIDERS INTO THE CURRICULUM

5.3.1 Orientation to recontextualising knowledge in the Professional Recontextualising Field of training providers

Texts produced by agents and agencies at this level (qualifications and skills programmes) represent the official pedagogic discourse (OPD) in the first layer of the Professional Recontextualising Field (PRF), which is later utilised by centres and private providers in the development of waste management programmes and materials. In the South African context, the centres and the providers (both private and public) need to develop the content knowledge for the courses, which is accredited by the Education and Training Quality Assurance bodies (ETQA).

Unit Standard 119555 is normally translated into a 'Module 1' in the training; hence I will use this co-referent to the Unit Standard as I proceed with the analysis. Planned for Module 1 are also the objectives noted above, which suggest that the providers in their training need to include values, and social related issues as well as the range of propositional, procedural, technical, planning and management, and legislative knowledge outlined in Tables 5.3 and 5.4, and column 1 of Table 5.5.

From the qualifications and the skills programmes developed and registered by both SAQA and the Sector Education and Training Authorities, the providers' task is to develop the learning programmes and learning materials. Providers of training are both providers of training and materials designers. A qualification may be achieved through different learning programmes . The providers use the same qualification and unit standards but their learning programmes are diverse. SAQA regulations (2000) assert that though the learning programmes are diverse, they should be educationally transformative, planned, coherent and integrated which may explain the strong field-aligned framing at the level of outcomes and objectives (see Table 5.6 above). Additionally, they should be built contextually on learners' existing frames of reference, which may explain the weaker classification, and framing in the Unit Standard when it comes to specified content, which was revealed in the analysis in Table 5.6 and Table 5.7.

At this level, knowledge is further recontextualised via the more specialising and contextualising recontextualising actions of the providers who:

- design the learning programme and its assessment thereof based on the framing in the unit standards and the purpose of the qualifications or skills programme;
- determine what knowledge is to be selected and included in the learning programme as per the outcomes-based prescriptions of the qualifications (including the specific outcomes, outcomes range, assessment criteria, assessment criteria range and EEK as outlined in Tables 5.3, 5.4 and 5.5);
- choose the content that best suits the knowledge areas, processes and procedures prescribed in the qualifications and the context that they will be working in;
- determine what matters and why it matters in the learning programmes in relation to the context of implementation;
- decide on the specific skills to be developed; and
- decide overall how this will be aligned to achieve the learning outcomes.

From this it is clear that the providers have a specific responsibility for content specification in relation to outcomes statements and context. Theirs is therefore an important mediating role between qualification and context, and thus also between the Field of Production, the Official Recontextutalising Field, and the Field of Reproduction (where the learners encounter the planned learning programmes). As noted above, they may also have the role of mediating the inconsistencies in the recontextualisations that occur between the Field of Production (knowledge generation) and the Official Field of Recontextualisation (qualifications design)

(revealed in Tables 5.5. and 5.6) and the realities and demands in the Field of Reproduction, although this is not an officially mandated role as the accreditation system tends to seek alignment oriented recontextualisation rather than critically oriented recontextualisation (Allais, 2006).

In this study two learning programmes using the SAQA mandated 'design down' approach and developed from Unit Standard 119555 are analysed to illustrate what knowledge is privileged at this level of recontextualisation and how that knowledge has been recontextualised. As noted in the introduction to this chapter, Unit Standard 119555 is used as an example to demonstrate this phenomenon.

5.3.2 Recontextualision of knowledge in the case of Provider One (P1)

In the next section, the contents of the learning materials produced by Provider One (P1) is compared with the contents of the Unit Standard to identify how the knowledge has been recontextualised into the learning programme. This analysis, represented in Table 5.8 below, is summatively developed from a more detailed analysis thereof contained in Appendix 12.

Table 5.8: Summative comparative analysis of knowledge included in Unit Standard 119555 and the learning programme developed / utilised for training by Provider 1 (see Appendices 4 and 12 for more detail)

	Unit standard prescription (US 119555)		**Learning programme indication (P1) –** *significant differences to the US are indicated in italics* (page references are to pages in the materials)
US title	**Separate handle store treat and transport waste**	**US title**	**Separate handle store treat and transport waste**
Purpose	• Classify separate, treat, store and transport waste responsibly and in compliance with legislation • Control, access and monitor the flow of incoming materials to a waste handling facility • Know and understand principles and concepts related to waste management and know and their application into practice • Know and understand methods of handling and transporting waste (SAQA, 2012, Registered unit standard, p. 1)	**At the end of the programme the learner will be able to**:	• Classify, separate, handle, treat, store transport and dispose waste *correctly, safely,* responsibly and in compliance with legislation. • Control, access and monitor the flow of incoming materials to a waste facility • *Discuss* principles and concepts related to waste management, waste minimisation and recycling • *Respond to and report threats or damage to health, safety or the environment* • *Compile relevant records* • *Recognise environmental pollution risks*
Specific Outcomes in US 119555	• SO 1: Separate, treat & store waste • SO 2: Transport waste • SO 3: Control, access and monitor the flow of incoming materials to a waste facility • SO 4: Recognise and report threats or damage to health, safety or the environment • SO 5: Compile relevant records	**Specific Outcomes of Module 1**	• *Recognise environmental pollution risks* • *Discuss principles and concepts related to waste management, waste minimisation and recycling* • *Classify,* separate, *handle,* treat, store transport and *dispose* waste *correctly, safely, responsibly and in compliance with legislation.* • Control, access and monitor the flow of incoming materials to a waste facility • *Respond* to and report threats or damage to health, safety or the environment • Compile relevant records *(Arranged here as per arrangement in the learning material)*
How the above are covered and dealt with in the module contents. The module is divided into 5 units and the specific outcomes, assessment criteria and embedded knowledge is covered in each unit. Below I show the units where these SOs, ACs and EEK are covered and the content included as specified in the materials and comments			
Number of the Specific Outcome	**Specific outcome**	**Units where SOs are covered**	**Content knowledge from each unit**
Specific Outcome 1	Separate, treat and store waste	Covered in Unit 2 with AC3 and AC4 pp.14- 20	UNIT 2 –AC3.1 Impacts of poor waste management. Health impacts of the following are discussed: Environmental pollution. For example, chronic conditions such as asthma; air pollution, for example, respiratory infections such as pneumonia; effects of water pollution, for example, diseases like bilharzia; and ground pollution, for example, toxins end up in rivers and streams

			3.Reasons why waste is not well-managed are discussed, for example, no infrastructure, no equipment, no refuse bins, no functional system and no enforcement of laws 4.Who is responsible for pollution prevention: Environmental laws and legal structures responsible for waste management in SA are introduced, for example, Constitution; National Environmental Management Act (Act 107 of 1998), Waste Act (Act 59 of 2008) etc. Snapshots on waste issues from each legal framework are discussed, for example, cradle to grave principle, polluter pays principle and precautionary principle 5. In the discussions of the Acts the discussion spreads to the roles of spheres of government, for example, roles of municipalities in waste management and the laws that govern those roles
		Covered in UNIT 3 with AC1 and AC2 p. 21-29	1. Waste classification – how to classify waste for example categories of waste Examples: General waste hazardous waste 2. Types of each are discussed – types of general waste examples: domestic waste; building and demolition waste; business waste inert waste. All the examples are explained. 3. Definitions of the types of waste 4. Steps in good management of waste, for example, avoid, minimise, reuse or recycle and treat Reduce, reuse, recycle, recovery and landfilling are discussed – waste management hierarchy is introduced 5.Waste minimisation, generation, separation at source and recycling are explained with examples of these processes
		Covered in UNIT 4 with AC2 pp. 30-35 Covered in UNIT 5 with AC1 and AC2 pp.36 - 40	1.Waste storage, collection and transport – terms were defined 2. Types of storage were discussed (primary and secondary storage: primary when waste is temporarily stored, secondary when the waste is taken from a primary to a larger container 3. Storage of hazardous waste. Discussion of the risks associated with different types of hazardous waste 4. Collection and transport. Different types of collection, for example, primary and secondary collection to a collection point. Secondary is done by means of vehicles. Primary collection is from source. Different ways of loading waste during collection and transporting. Important points about off-loading of waste.

			1. Waste Treatment. What it is? Different types of waste treatment 2. Types of waste are tabled with different types of treatment 3. Compaction of disposable goods, for example, cars are squashed 4. Garden or biodegradable – shredding and chopping and composting 5. Hazardous waste – physical treatment; chemical, biological treatment, encapsulation, ash blending, incineration and thermal non-burn treatment 6. Tabled types of hazardous waste and how it is treated 7. Radioactive waste- not discussed only referred to the Act that informs its use 8. Disposal in the landfill
Outcome Range for SO1	Includes handling and treatment methods for water, effluent, waste, solids and gas Treatment includes shredding, chopping, baling, compacting, neutralising, blending, incinerating, densifying etc. • ***Note:*** *All SOs are further specified using ORs.*	**No mention of ORs in the materials of Provider 1 but they are discussed in the learning materials**	• Waste Treatment. What it is? Different types of waste treatment • Types of waste are tabled with different types of treatment • Compaction of disposable goods, for example, cars are squashed • Garden or biodegradable – shredding and chopping and composting • Hazardous waste and how it is treated: physical treatment; chemical, biological treatment, encapsulation, ash blending, incineration and thermal non-burn treatment • Radioactive waste – not discussed, only referred to the Act that informs its use • Disposal in the landfill is not promoted but can be used as last resort. The content knowledge in the outcome range is included.
	Included in AC1; Assessment Criteria Range 1 (ACR 1 and in the EEK in the US which requires knowledge of categories of waste (see Table 5.3)	**Introduction is inclusive of the definition of waste and the explanation of types of waste. It also traces the historical perspectives of waste**	**Types of waste** • *Natural and human waste* • *Natural waste is derived from all living organisms including humans and humans produce extra waste.* • *Included also in the introduction is historical perspective of waste and waste management, for example, a hundred years ago, societies around the world were producing little waste as they were living subsistence lifestyles They did not use biodegradable items. As technology developed, waste production became complicated. Civilisation brought accumulation of waste. People were unable to manage their waste and sewage systems were*

			developed. During Industrial Revolution waste management became complicated Complex chemicals and compounds got into the stream and changed the nature of waste. Capitalism brought a culture of consumerism. Waste will never disappear as long as people are still consuming goods
Assessment criteria	**AC1:** Waste is separated into various categories and processed appropriately. **AC 2:** Handling treatment and storage methods are selected and applied for each category of waste correctly. **AC 3:** Work is carried out safely and with due care for self, fellow workers, equipment, materials and the environment. **AC 4:** Environmentally damaging practices are recognised and reported timeously and accurately. **AC 5:** Incidents and problems related to waste handling storage and treatment are discussed and explained appropriately and accurately.	**AC1 and AC2 Covered in Unit 2** **Covered in Unit 3** **Covered in Unit 4** **Covered in Unit 5**	1. Waste classification – how to classify waste, for example, categories of waste e.g. general waste, hazardous waste. 2. Types of each are discussed – types of general waste, for example, domestic waste; building and demolition waste; business waste; inert waste. All the examples are explained. 3. Definitions of the types of waste are provided 1. Hazardous waste need to be stored in special containers 2. Those handling it need to receive special training 3. They must be provided with adequate protective clothing 4. Different ways of loading waste during collection and transporting are tabled 5. Important points about safe ways of loading of waste are discussed. 6. Collection workers should be provided with adequate protective clothing ***In the materials, environmental damaging practices are addressed but the way they are reported is left out*** • Waste treatment. What is it? Different types of waste treatment • Types of waste are tabled with different types of treatment • Compaction-done on disposable good for example cars are squashed • Garden or biodegradable – shredding and chopping and composting • Hazardous waste and how it is treated: physical treatment; chemical, biological treatment, encapsulation, ash blending, incineration and thermal non-burn treatment
Assessment Criterion Range	**ACR 1:** Various categories: general, hazardous, biodegradable, recoverable, etc.	**ACRs are not mentioned in the materials but the content knowledge relevant to**	1. Waste classification – how to classify waste, for example, categories of e.g. general waste, hazardous waste 2. Types of each are discussed – types of general waste, for example, domestic waste; building and demolition waste; business waste, inert waste. All the examples are explained.

	ACR 3: Safety: correct techniques and procedures are used to handle waste; safe working practices are applied, appropriate protective clothing and equipment is used. **ACR 5:** Incidents and problems: includes impact of hazardous waste on the environment. ***Note:*** *not all ACs are further specified with ACRs*	**and guided by the three ACRs 1,2 and 3 is included**	Hazardous Waste 3. Definitions of the types of waste are given 4. The types of hazardous waste and how they are treated and the risks attached to them are tabled 5. Health care risks waste, for example, blood and needles; risk associated with it is spread of infections 3.Toxic waste, e.g pesticides risk associated with it acute or chronic toxicity; malignancy, mutations or birth defects 4. Flammable waste: explosions of fires 5. Hazardous waste need to be stored in special containers 6. Those handling it need to receive special training 7. They must be provided with adequate protective clothing
Specific Outcome 2	• SO 2: Transport waste	**Covered in UNIT 4 with AC1**	Collection and transport. Different types of collecting Types of collection, for example, primary and secondary collection to a collection point. Secondary collection is done by means of vehicles. Primary collection is from source. Different types of vehicles for transporting are discussed. For examples; wheelbarrows, carts, tractor-trailers, trucks, compactor truck. When and where they are used are discussed. Transporting hazardous waste and its dangers. Different ways of loading waste during collection and transporting are tabled. Important points about safe ways of loading of waste are discussed. Collection workers should be provided with adequate protective clothing. *For SO 2 the knowledge specification is related to on-site movement of waste, with emphasis on quality standards, health and safety and incident management.*
Outcome range for SO2	Transport refers to on-site movement of waste	**No mention or ORs in the materials of Provider 1**	***It is implied in the content knowledge as there is a discussion of the transport of waste at different sites implied in the content knowledge of unit 4***
Assessment Criteria for SO2	**AC 1**: Waste is loaded, moved, off-loaded and positioned efficiently and as required. **AC 2**: Operations are carried out to quality standards efficiently and safely.	**Covered in UNIT 4 with AC1**	Important points to remember while loading and unloading waste: If more than 15kg should be loaded mechanically Materials on a pallet can be moved by forklifting objects Check the forklift for damaged parts before loading

	AC 3: Work is carried out safely and with due care for self, fellow workers, equipment, materials and the environment. **AC 4:** Incidents and problems are reported timeously and appropriate action is taken.		Load the items safely by putting heavy items at the bottom Do not enter a trolley to load and unload An overloaded forklift is unsafe Always read the labels on drums before loading them. Bulging drum may indicate that there is a reaction inside. Drums must be handled with extreme caution. Workers need to know the protective clothing to use e.g. safety gloves when handling chemicals, hard hats where there is danger of falling objects This is content concerned with health and safety care for people and care for equipment. Healthy and safety standards are put into practice. ***Issues of incidents and how they are reported and actions to take are not addressed in the learning materials***
Assessment Criterion Range	**ACR 2:** Operations include securing and releasing load, placing load correctly. **ACR 3:** Safely: correct techniques and procedures are used to transport waste; safe working practices are applied, appropriate protective clothing and equipment is used. **ACR 4:** Incidents and problems could include non-compliance with legislation and site or equipment requirements; inappropriate waste; hazardous conditions.	**Not indicated in the materials but the information relevant to them is addressed**	Important points to remember while loading and unloading waste: If more than 15kg should be loaded mechanically Materials on a pallet can be moved by forklifting objects Check the forklift of damaged parts before loading Load the items safely by putting heavy items at the bottom Do not enter a trolley to load and unload An overloaded forklift is unsafe Always read the labels on drums before loading them. Bulging drum may indicate that there is a reaction inside. Drums must be handled with extreme caution. Workers need to know the protective clothing to use e.g. safety gloves with when handling chemicals, hard hats where there is danger of falling objects Hazardous waste is addressed in unit 5, for example, the types of hazardous waste as well as their risks but there is no reference to issues of compliance and non-compliance. The environmental principles have been developed in the legislation. A number of legislation addressing issues of waste are listed in the materials.
SO3	Control, access and monitor the flow of incoming materials to a waste facility		*Not covered in the materials. No discussion of the monitoring of the flow of materials to the landfill site.*
Outcome Range for SO3	Incoming materials include waste, consumables and equipment.	No mention of ORs in the materials of Provider 1	*Not covered in the materials. No discussion of the monitoring of flow of materials to the landfill site*

Assessment Criteria for SO3	**AC 1:** Materials are allowed to enter the site in accordance with organisational procedures. **AC 2:** Non- compliant waste recognised and appropriate action is taken. **AC 3**: Security of the facility, equipment and resources is maintained appropriately.		*All the ACs for SO3 are not covered in this unit standard in the materials. These are the activities which take place in the landfill and they are not addressed in the learning materials*
Assessment Criterion Range for SO3	**ACR 3:** Includes recognising and reporting potential and/or actual breaches of security, accounting for consumables used and storing or immobilising equipment and resources.		How the waste is stored in unit 4 under waste storage. It explains how hazardous waste is stored. It needs to be stored in special containers to avoid injury to people *but the issues of reporting potential and breaches of security are not addressed in the materials*
Specific Outcome 4	• SO 4: Recognise and report threats or damage to health, safety or the environment	With AC1 and AC2 of SO4 it is covered in Unit 2 Covered in Unit 1 with AC1 of SO4	Discussed in Unit 2 that waste is detrimental to health of the people and the safety of the environment.
Outcome Range for SO4	This outcome includes an awareness of appropriate preventive, corrective or remedial actions	Addressed in Unit 3 with SO1, AC1 and AC2	These issues are implied in the materials. Issues of prevention and corrective remedial actions are addressed on the waste management systems for example waste avoidance and minimisation, separation at source and recycling
Assessment Criteria for SO4	**AC 1:** Potential dangers to health, safety and the environment, which can arise during the processes of handling, separating, treating, storing and transporting waste, are identified and described accurately and appropriately. **AC 2:** Measures which can be taken to prevent, correct or remedy threats or damage to health, safety or the environment are explained correctly		• Important points to remember while loading and unloading waste are addressed, for example: • If more than 15kg should be loaded mechanically • Hazardous waste need to be stored in special containers • Those handling it need to receive special training • They must be provided with adequate protective clothing • Different ways of loading waste during collection and transporting are tabled • Important points about safe ways of loading of waste are discussed. • Collection workers should be provided with adequate protective clothing.
Specific Outcome 5	Compile relevant records		***Not discussed in the materials just implied.*** *Available in the Unit Standard but not included in the Learning Programme*
Outcome Range for SO5	Includes incident reports, operational records, maintaining confidentiality of information (organisational and client)	**No mention or ORs in the materials of Provider 1**	*Available in the Unit Standard but not included in the Learning Programme*

	SO 5: Compile relevant records *Here the knowledge specifications relate to incident reporting, site-based regulations, and health and safety.*		*Available in the Unit Standard but not included in the Learning Programme*
	SO 3: Control, access and monitor the flow of incoming materials to a waste facility *Here knowledge specification is related to on-site organisational procedures, recognition of non-compliance, appropriate responses, and security of the facility.*		*Available in the Unit Standard but not included in the Learning Programme*

In the next table, Table 5.9, I summarise the types of knowledge identified in Provider 1's materials. All the units of P1's Module 1, namely Unit 1 to 5 were read through and analysed. I identified the types of knowledge per unit. The full analysis of this is contained in Appendix 12. Here I offer a summative version of it showing examples of the different types of knowledge from the empirical data, as well as a summative comment of what was included and excluded as this helps to establish what knowledge was foregrounded in the Module.

Table 5.9: Summative view of types of knowledge emphasised in Module 1 with some illustrative empirical examples identified in the materials of Provider 1 (see Appendix 12 for further in-depth analysis)

Types of knowledge (as identified in Tables 4.1-4.2 and Tables 5.3 and 5.4)	**Knowledge in Unit Standard 119555 in the Official Recontextualising Field** (using objectives outlined above and drawing on further detail from Table 5.3 & 5.4 above)	**Examples from P1's materials**	**Comment on P1's Module contents overall** (see Appendix 12) – considered in relation to Table 5.3 and 5.4 above as well as Table 5.7
Propositional knowledge Emphasised in SO 1	Understand principles and concepts related to waste management and their application in practice	1. Waste classification – how to classify waste, for example, categories of waste e.g. general waste hazardous waste. 2. Examples of each are discussed – types of general waste examples: domestic waste; building and demolition waste; business waste inert waste. All the examples are explained as well as types of waste they are referring to. 3. Definitions of the types of waste 4. Steps in good management of waste, for example, avoid, minimise, reuse or recycle and treat Reduce reuse recycle recovery and landfilling are discussed – Waste management hierarchy is introduced 5.Waste minimisation, generation, separation at source and recycling are explained with examples of these processes 6.Knowledge of processes and procedures of waste treatment methods: Physical treatment Chemical treatment Biological treatment Encapsulation Incineration Thermal, non-burn treatment	*The module includes a focus on types of waste* *Classification of waste* *includes the following categories: domestic waste; building and demolition waste; business waste inert waste* *Knowledge of the steps in waste management* *Waste avoidance, minimisation, separation at source, collection, transport, treatment and disposal* *Knowledge of the waste hierarchy* *It also includes knowledge of waste treatment methods, for example, physical treatment* *Chemical treatment* *Biological treatment* *Encapsulation* *Incineration* *Thermal, non-burn treatment* *Though the above processes are named, they lack the detail of the scientific knowledge of how the processes take place.* *It also excludes the legal and policies guiding these processes* *It excludes the details associated with the* ***disposal of the different types of waste as well as the activities that take place in the disposal facilities e.g*** *Materials allowed to enter the site in accordance with as prescribed by policy and organisational procedures.* *They did not get to the detail of* ***the knowledge of*** *non-compliant waste and compliant waste and how it is to be recognised and accepted in the disposal facilities.*

Legislative knowledge Implied in SO 1, 2, 3, 4, 5 but not explicitly emphasised	Pertaining to policy and legal frameworks in waste	National legislation, namely Clause 24 of the Constitution, National Environmental Management Act (Act 107 of 1998), and National Environmental Management: Waste Act (Act 59 of 2008) are dealt with but not in too much depth.	The module includes reference to national level policy e.g Constitution, NeMA act; NEMA waste act and policies guiding the municipalities It does not include specific reference to organisational policy, or site-specific policies and standards. The national policies too are only mentioned. There is no explanation of how they influence and relate to waste management in the country. The principles of cradle to grave, polluter pays and precautionary principles are explained.
Procedural knowledge Emphasised in SO 1, 2, 3, 4, 5	Knowledge how procedures, processes, techniques & skills) Indicator: Waste management from the point of generation to the point of disposal	Functional parts of waste management processing are covered: - Waste avoidance - Separation at source: materials recovery for recycling - Primary and secondary storage - Collection, treatment and disposal (pp. 25 -27) - Steps of management of waste are tabled: - Avoid, minimise, reuse, recycle, recover and landfill It covers how hazardous waste is treated and managed. It addresses the following procedures: physical treatment, chemical, biological treatment, encapsulation, ash blending incineration and thermal non-burn treatment and the waste hierarchy	The focus of the module is on procedural and technical knowledge. Different types of waste require different types of treatment (e.g. organic waste can be composted; medical waste must be incinerated). The range of treatment methods relevant to the different waste streams are not outlined in the Unit Standard. It covers how hazardous waste is treated and managed. It addresses the following procedures: physical, chemical, biological treatment, encapsulation, ash blending, incineration and thermal non-burn treatment and the waste hierachy It does not demonstrate how each process takes place. It does not include practical activities where the participants at level 2 are given a chance to practice what they have learnt It does not cover the scientific and technological aspects of the two procedures (treatment and waste management.
Technical Knowledge Emphasised in SO 1, 2, 3, 4, 5	Pertains to technical skills and methods	Physical – Physical methods are used to remove toxic or hazardous materials Chemical – Hazardous nature is lowered by changing its chemical nature Biological – Microbes are used to reduce the dangerous nature of waste Encapsulation – Waste is covered with cement to make safe (pp. 35-37)	The focus of the module is on procedural and technical knowledge (see above), and associated technical knowledge. It covers treatment, explains what exactly it is and the types of treatment for hazardous waste. It does not cover the methods of treatment and technical knowledge embedded in the practical activities of these processes. It is quiet on the legal factors guiding these processes.
Social knowledge Emphasised in SO 4	Pertains to influences of people	Land pollution - is the consequence of increasing populations living in cities and towns and an increase in factories and business. Man's [sic] increasing demands on	There is limited coverage of social knowledge in the module. The module covers the wider context of how the humans impact on the causes and effect of waste on mankind. It covers potential dangers related to workers' health and safety.

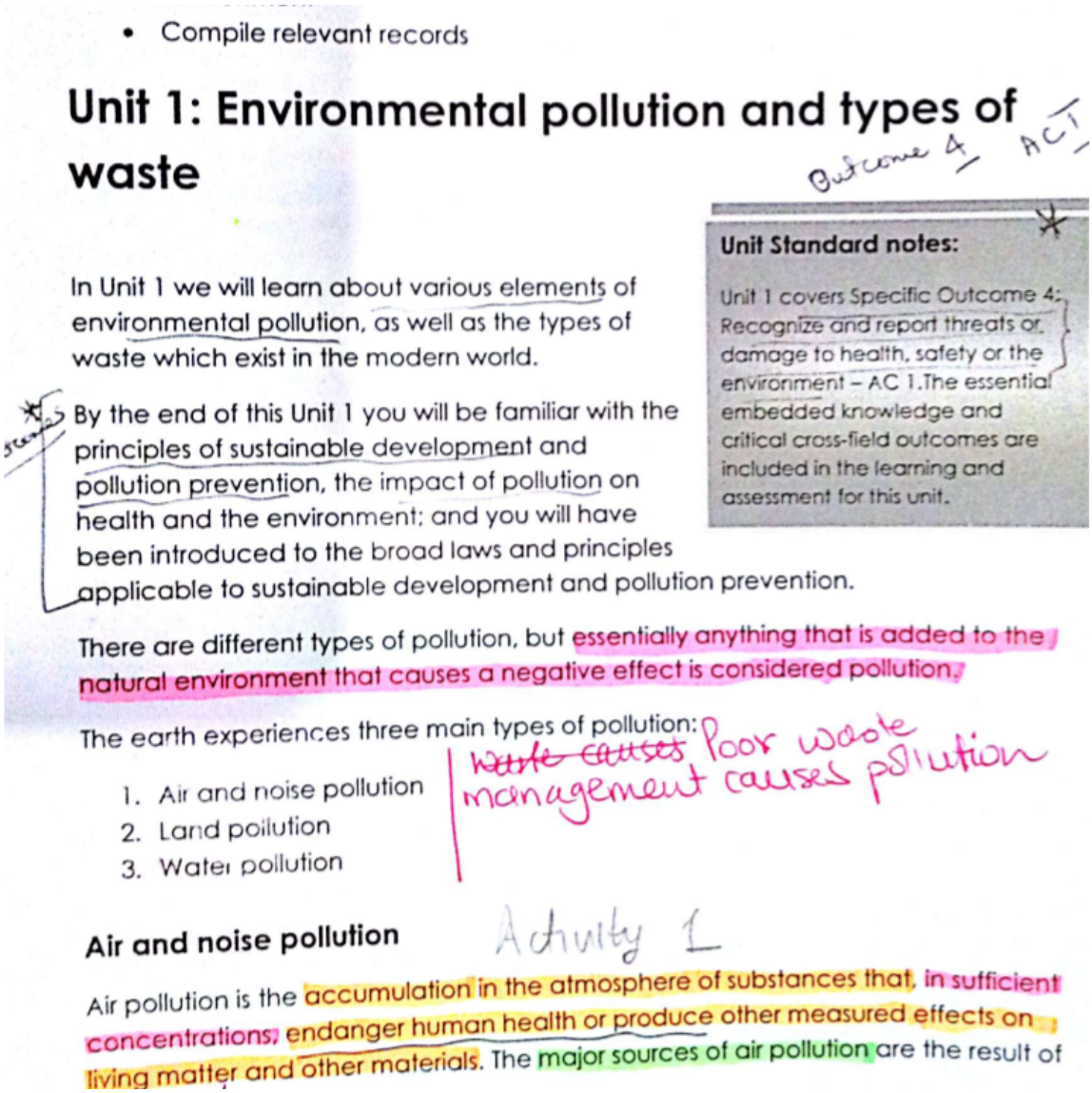
		the environment and its resources is putting our planet at risk (p. 7)	It covers how waste management is related to people's values and ethics. It does not cover how different cultures impact on the management of waste.
Economic knowledge Not emphasised in any of the SOs	Pertaining to money, fund raising and job creation issues	**Polluter pays principle –** Whoever is responsible for environmental damage or pollution must pay all costs to repair the damage and prevent any further environmental damage	There is very little reference to economic knowledge in the module. Where it is mentioned, it is mentioned at a high level of 'polluter pays principle' It does not include knowledge of waste entrepreneurship, and knowledge of how to participate in the waste economy. It discusses issues of recycling (pp. 26-27) but not in relation to how the people can benefit from it economically.
Institutional and planning knowledge Emphasised in SO 3 and 5	Pertaining to planning and management on site or in organisational context	Not included in module 6	As noted above in Table 5.6 SO 3 and SO 5 are not included in the learning programme. As such, this type of knowledge is largely excluded from the learning programme.
Historical knowledge Not emphasised in SOs	History of how waste management has changed over time	The historical aspects of waste management are discussed in the introduction is historical perspective of waste and waste management for example: 'A hundred years ago societies around the world were producing little waste as they were living in subsistence lifestyles They did not use biodegradable items. As technology developed waste, production became complicated. Civilisation brought accumulation of waste. People were unable to manage their waste and sewage systems were developed. During Industrial Revolution waste management became complicated. Complex chemicals and compounds got into the stream and changed the nature of waste. Capitalism brought a culture of consumerism.	The historical aspects of waste management were not indicated in the unit standards but they are discussed in the introduction as historical perspective of waste and waste management for example: They use the historical events to show the developments in waste management They show how the changes in lifestyles affect the waste management scenarios in countries. "A hundred years ago, societies around the world were producing little waste as they were living in subsistence lifestyles. As technology developed waste, production became complicated. Civilisation brought accumulation of waste. People were unable to manage their waste."

From the analyses presented above in Tables 5.8 and 5.9, it is clear that the providers *have* taken up the responsibility that is left to them by the under-specification of content in relation to the outcome statements (reported on in Table 5.3, 5.4 and 5.6 in section 5.2 above). While sticking quite closely to the Unit Standard specifications, it is possible to see some gaps that were not covered, and some changes or expansions in interpretation in the recontextualisation process as shown in Table 5.8 and 5.9. The materials designers' recontextualisation has two perspectives. There is evidence that the materials designers are recontextualising knowledge from both the Field of Production and the qualification specifications found in the unit standard. There is also evidence that they are selectively appropriating knowledge and ideologically transforming it. These two perspectives will be discussed in more detail below.

According to the qualification, Unit Standard 119555 has five outcomes with further specifications, which are outlined in Table 5.3. Table 5.9above shows that the provider has increased the number of outcomes to six. The provider included the five outcomes prescribed by the unit standard but combined the one on "Transporting Waste" with the one on separating, sorting, and treating Waste. Two additional outcomes were added that focus on introductory/ orienting knowledge covering wider pollution concepts (not in the Unit Standard) and more emphasis on types of waste and categories and classification of waste – which is required in the assessment criteria, outcome range and assessment criteria range of SO1, but not specified as such in the actual outcome and how it is phrased.

In the introduction to the Module, the provider introduced different types of waste which are discussed as natural and human waste (these categories differ from the specifications in the Unit Standard). In unit one, a new outcome reads: "need to be able to recognise environmental pollution risks". In this outcome the relationship between pollution and waste is discussed which serves as a basis for introducing waste management – again this is not specified in the Unit Standard but the provider has managed to link it well with his introduction of waste management. In unit two, the materials discuss the impacts of poor waste management on health and safety of both humans and the environment. In unit three, the classification of waste is explained inclusive of both general and hazardous waste. This is further elaborated by the introduction of the waste hierarchy and each level of the waste hierarchy is described at length. As revealed in the analysis above in section 5.2 (see also Table 5.4), the unit standard is not explicit on inclusion of knowledge framed within the waste hierarchy, but it is alluded to in the assessment criteria of Specific Outcome 1. Table 5.5 above shows that reference to the waste

hierarchy is a strong discourse in the Field of Production. It is therefore clear that the provider has used the discourse from the Field of Production to interpret the prescriptions in the Unit Standard in more detail. In units four, (4) five and six, the provider discusses the elements of SO1 and SO2 "separate, treat and store waste" and "transport waste" involving waste storage, collection, transport and waste treatment. The applied flow of events in these processes (i.e. the full scope of applied procedural knowledge applied to different types of waste streams) is not explicit in the unit standard. In the recontextualisation of the knowledge via the training programme design, the training provider addressed the lack of process flow knowledge in the Unit Standard by using the waste hierarchy as a framework as articulated in the field of production to frame the application / process dimensions of waste management. Parts of the units from one to five are copied below.



- Compile relevant records

Unit 1: Environmental pollution and types of waste

Outcome 4 ACT

Unit Standard notes:

Unit 1 covers Specific Outcome 4: Recognize and report threats or damage to health, safety or the environment – AC 1.The essential embedded knowledge and critical cross-field outcomes are included in the learning and assessment for this unit.

In Unit 1 we will learn about various elements of environmental pollution, as well as the types of waste which exist in the modern world.

By the end of this Unit 1 you will be familiar with the principles of sustainable development and pollution prevention, the impact of pollution on health and the environment; and you will have been introduced to the broad laws and principles applicable to sustainable development and pollution prevention.

There are different types of pollution, but essentially anything that is added to the natural environment that causes a negative effect is considered pollution.

The earth experiences three main types of pollution:

1. Air and noise pollution
2. Land poilution
3. Water pollution

~~Waste causes~~ Poor waste management causes pollution

Air and noise pollution

Activity 1

Air pollution is the accumulation in the atmosphere of substances that, in sufficient concentrations, endanger human health or produce other measured effects on living matter and other materials. The major sources of air pollution are the result of

Types of Waste Activity 2

There are various types of waste that cause pollution, with three main categories:

Primary Waste – these are waste substances produced directly from the source: e.g CO_2 from car emissions, animal wastes from abattoirs.

large majority is natural waste incl hum was

Secondary Waste – these are waste substances produced when primary wastes react with each other and other substances: e.g. leaking organic chemicals in a waste site mixing and forming even more toxic volatile compounds.

Precursor Waste – these are waste gases that react in the air to form other pollutants: e.g. produced nitrogen reacting with sunlight pollutants forming low-level ozone, which harms human and animal health.

vocabulary

Wastes now occur in every environment on the planet, from sewage and rubbish on Antarctica to plastic floating in every sea and pollutants in every layer of our atmosphere.

A prime example of waste being present in all environments is the 'Great Pacific Garbage Patch'. In the Pacific Ocean a gyre (vortex or whirlpool) exists hundreds of kilometres from land, which has collected to form a virtual island of pelagic plastic and chemical sludge. The earth's natural ocean and wind currents form a whirlpool, while mans unnatural waste is pulled from all over the worldto form a massive environmental eyesore (80% originates from land, 20% from ships). Disturbingly, there are actually five notable gyres in the world's oceans, all of which collect waste in the same way.

Figure 1: A river choked with plastic, while a man 'fishes' for usable waste



We now know that air, land and water are where all pollutants take their effect. The different types of wastes can be further broken down:

would such a large % be hum

Unit 2: Impacts of poor waste management, and principles of sustainable living

Unit Standard notes:

Unit 2 covers Specific Outcome 1: Separate, treat and store waste – AC3, AC4; and Specific Outcome 2: Recognize and report threats or damage to health, safety or the environment – AC1 & AC2. The essential embedded knowledge and critical cross-field outcomes are included in the learning and assessment for this unit.

In Unit 1 we learned about the different areas of pollution (land, water and air); and went into the specifics of different types of waste. In Unit 2, we will we will learn about the impacts and effects of poor waste management.

To recap, waste is any unwanted thing that we throw away out of our homes, offices, shops or industries, or that we store to re-use or recycle later. We also refer to waste as refuse or rubbish.

Poor waste management is a key factor in the pollution of our environment; with the opposite meaning that excellent waste management will keep our environment as safe and sound as possible.

What are the health impacts of environmental pollution? Activity 3

The health impact of different kinds of pollution on humans varies considerably depending factors such as how much pollution there is, the age and sensitivity of a person and a person's general health condition. For example, the elderly and the very young are more easily affected and those with chronic conditions such as asthma, heart or lung disease will suffer more.

The health effects of air pollution: Activity 4

Air pollution is a major cause of health problems, and can be both short term and long term. Typical short term effects of air pollution include irritation to the eyes, nose and throat and upper respiratory infections such as pneumonia or bronchitis; headaches, nausea and allergic reactions. Long term health effects (from sustained exposure to air pollution) include chronic (for which there is no cure) respiratory disease, lung cancer, heart disease, brain damage, nervous disorders and liver or kidney damage.

Wastes can also cause unpleasant, even sickening odours. Bissaria waste site in Durban smells so bad that tall pipes along its perimeter constantly release

A type of general waste that does not change, burn, react physically or chemically with other substances, biodegrade, impact negatively on the environment or cause pollution. Examples include soil, concrete, ceiling board.

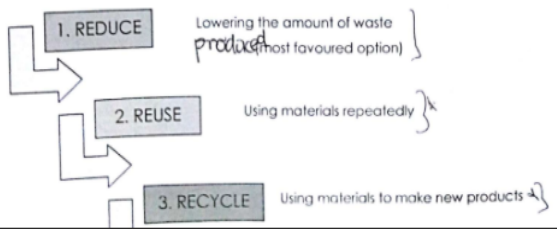
***Now** that we are aware of how waste is classified, we can begin to look at the systems that we use to manage waste in South Africa.*

The steps in good management of waste: the hierarchical management of waste

With an ever growing population and the increase in size of communities, more waste is being generated and there is less land available for the disposal of the waste. The focus of a good waste management system is therefore to **reduce** the amount of waste going to a landfill site.

1. The first step in good waste management is to **avoid** making the waste in the first place
2. The second step is to **minimize** the amount of waste generated by **reusing or recycling** the waste. An example of reuse is to use the other side of a piece of paper before throwing it away. An example of recycling is to reprocess the paper and use it to make paper again.
3. The third step is to **treat** the waste physically, chemically or with thermal treatment to reduce the quantities further
4. Finally what cannot be re-used or recycled must be taken to a **landfill** site or rubbish site.

The diagram below shows how the amount of waste is reduced before it reaches the landfill site, going through the **waste management hierarchy**.



Unit 3: Waste classification and waste management

Unit Standard notes:

Unit 3 covers Specific Outcome 1: Separate, treat and store waste – AC 1 & AC 2; the essential embedded knowledge and critical cross-field outcomes are included in the learning and

In Unit 1 we learnt about environmental pollution and different types of waste, and in Unit 2 we looked at the legal structures in place that hold government responsible for waste management. To further this on a practical level, we well be looking at how to classify waste and the logical steps for waste management.

1. How to classify waste
2. The steps for managing waste
3. Waste minimization and recycling

How is waste classified?

The two **main categories** of waste are **General Waste** and **Hazardous Waste**.



General Waste

General waste does not pose a threat to people or the environment unless it is not managed well.



Hazardous Waste

Unit 4: Waste storage, collection and transport

In the section on waste classification, we learnt about the first 3 elements/functional parts of a good waste management system: waste avoidance, waste generation and separation at source.

Unit Standard notes:

Unit 4 covers Specific Outcome 1: Separate, treat and store waste – AC 2; and Specific Outcome 2: Transport waste – AC 1. The essential embedded knowledge and critical cross-field outcomes are included in the learning and assessment for this

In Unit 4 we will look at elements 4 to 6: primary and secondary storage, collection, and transfer/transport. We will learn how to store waste correctly at the source, how to store hazardous waste correctly, and how to collect → load → transport → unload safely and correctly.

What is the difference between storage, collection and transport?

- Storage = safe containerization of waste
- Collection = how waste is picked up and loaded
- Transport = how waste is moved and off-loaded

4. Primary and Secondary Storage

Part 4: Primary and Secondary Storage:



Module 6 & 7: Better Waste Mana

waste than a home, thus it would collect in waste basket and then be transferred to a secondary storage area such as a skip.

To prevent overflow and spillage from polluting the environment, any storage container (whether primary or secondary) must be big enough to hold all the refuse generated until a removal service removes it.

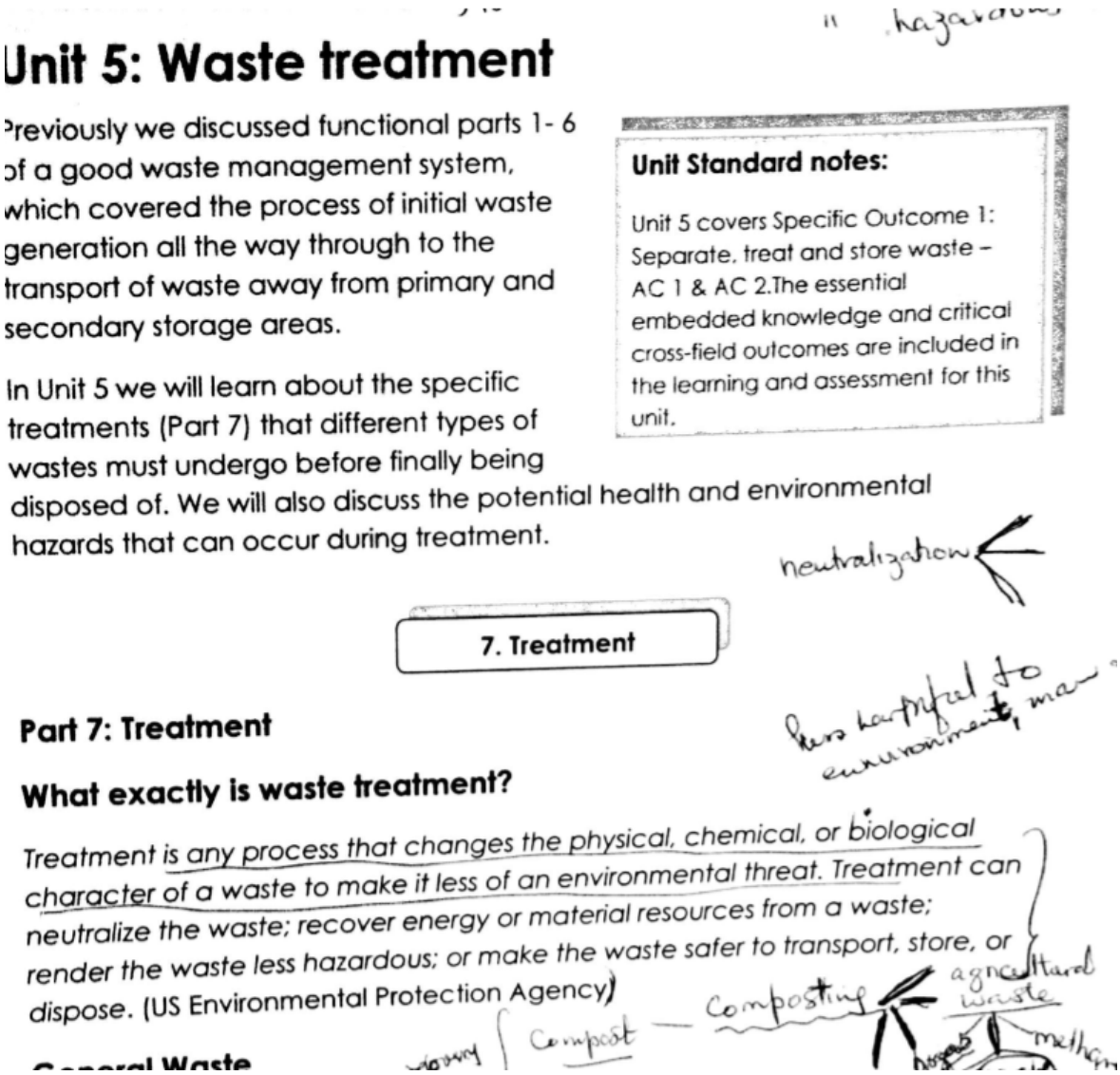
As you have already learnt, it is important to minimize the amount of waste going to a landfill site. Materials that can be re-used or recycled must be identified and not thrown away with the rest of the refuse. It is therefore necessary to have different types of containers for the different categories of waste collected.

Storage of hazardous waste

Hazardous waste is more harmful than general waste and needs to be stored in special containers to avoid injury to people or damage to the environment.

The following table gives examples of the risks or danger associated with different types of hazardous waste:

Type of hazardous waste	Risk or danger
Health care risk waste e.g. blood, sharps	• Spread of infection • HIV/AIDS, hepatitis etc
Toxic waste e.g. pesticides, cyanide	• Acute or chronic toxicity • Malignancy • Mutations or birth defects



Unit 5: Waste treatment

Previously we discussed functional parts 1- 6 of a good waste management system, which covered the process of initial waste generation all the way through to the transport of waste away from primary and secondary storage areas.

Unit Standard notes:

Unit 5 covers Specific Outcome 1: Separate, treat and store waste – AC 1 & AC 2.The essential embedded knowledge and critical cross-field outcomes are included in the learning and assessment for this unit.

In Unit 5 we will learn about the specific treatments (Part 7) that different types of wastes must undergo before finally being disposed of. We will also discuss the potential health and environmental hazards that can occur during treatment.

7. Treatment

Part 7: Treatment

What exactly is waste treatment?

Treatment is any process that changes the physical, chemical, or biological character of a waste to make it less of an environmental threat. Treatment can neutralize the waste; recover energy or material resources from a waste; render the waste less hazardous; or make the waste safer to transport, store, or dispose. (US Environmental Protection Agency)

In working with the same Unit Standard 119555, the provider created his own absences through selective appropriation and ideological transformation of the Unit Standard's outcomes. In the development of the materials (as shown in Table 5.9 above), two specific outcomes were not included in the materials, namely SO3 and SO5: "control, access and monitor the flow of incoming materials to a waste facility" and "compile relevant records". This shows that learning about the technical and institutional management processes related to how incoming waste is controlled and monitored in waste facilities has been left out this unit standard; they may be addressed somewhere else. The activities around control and monitoring of waste in waste management facilities requires a number of diverse procedures to ensure compliance with legislation. Learners need knowledge of different types of facilities as well as knowledge

of materials that can and cannot be deposited. Learners also need to understand how to compile and keep technical records of waste deposited in waste facilities. As outlined in the outcome range statements, the assessment criteria and assessment criteria range statements, this also requires familiarity with organisational procedures, maintaining security of facilities, recognising and reporting potential or actual breaches of security and enabling and maintaining security of the facility and its equipment. Associated with this organisational function (outlined in SO4) is the need to compile incident reports, maintain operational records and maintain confidentiality of information (SO5). It would seem therefore that the provider selected to exclude the organisational and institutional management dimensions of waste management training in the EPWP learners' context in this unit standard, effectively excluded organisational and institutional planning knowledge from the training programme, while emphasising propositional, procedural and technical knowledge of waste management as shown in Table 5.8 above. Another absence is historical knowledge, which is present in the Field of Production, but not in the Official Recontextualising Field, or the Professional Recontextualising Field in P1's materials.

What is not clear and difficult to determine from the analysis of the data are the reasons why the two specific outcomes (SO3 and SO5) were not dealt with in depth. Recontextualisation of the learning outcomes and the absence of attention being given to some of them may be influenced by the training providers' assumptions about the contextual relevance of the latter two excluded learning outcomes for EPWP training contexts. Also using selective appropriation these may have been removed from this unit standard and discussed somewhere else. As noted in Chapter 1, workers in the EPWP programmes are on temporary contracts and are not permanent employees of waste management facilities. They are also new to waste management – thus one could assume the training provider / learning programme developers thought workers would require more propositional, technical and procedural knowledge to begin with and less organisational and management knowledge. This reflects ways in which the developer's assumptions influence the delocation and relocation of knowledge in training programme design via selective appropriations and ideological transformations.

Even at this level, where one can detect selective appropriations and ideological transformations of the discourse in the recontextualisation process as shown in Tables 5.8 and 5.9 above, there is still strong framing (F+), as the control of the selection of knowledge and design of the materials is still largely influenced by the prescriptions of the specialists/

managers who have influenced knowledge construction in the Field of Production and in the Official Recontextualising Field where the qualification was designed. It is possible to see from the above analysis, however, that the framing is weakened (F to F-) in relation to the Field of Production, as the providers of training in the Professional Recontextualising Field also take up some aspects of control over what they are offering in relation to the unit standard prescriptions (indicated by the left out specific outcomes and the selective appropriations and ideological transformations of the unit standards' discourse). Learners, however, still have no control in the selection of knowledge in the development of these learning programmes at this level and therefore their control and framing over them is weak (F-). One could, for example, consider whether the EPWP workers would have liked to have more training on how to manage waste successfully in a more structured organisational context or waste management facility, and one could surmise that this may well have been a potential area of possibility for strengthening their capabilities for accessing more permanent work, and it may therefore have been met with a positive response from them. As the recontextualisation process is currently structured, there is, however, little opportunity for them to deliberate on this potential choice, which was made for them by the training providers' recontextualisation decisions, effectively excluding them from this learning opportunity. This issue will be discussed further in Chapters 6, 7 and 8.

On the other plane it shows that the classification is strong (C+) between the Field of Production and the Field of Reproduction, the boundary between the knowledge prescribed by the level of production and everyday knowledge is insulated firstly by the Unit Standard designers, and then by the training providers who emphasise procedural, technical and propositional knowledge and in so doing exclude everyday knowledge of workers. There is no flow of waste management knowledge into the waste management discourse.

As indicated in Table 5.8, the materials of Provider 1 also bears some of the main characteristics and the types of knowledge promoted in the Field of Production, outlined in Table 4.1, 4.2, 4.3 and further analysed in Table 5.3, 5.4 and 5.5 in relation to recontextualisaion into the Official Recontextualising Field. Here, in the Professional Recontextualising Field, there is evidence of alignment with the dominant discourse in the Field of Production and Official Recontextualising Field, but also some deviation, as noted above. Table 5.8 shows that P1's materials contained propositional, legislative, economic, procedural, technical and social knowledge, but largely excluded organisational and management knowledge. All these types

of knowledge (propositional, legal, economic, procedural, and technical) display specialist knowledge, skills, procedures and processes in waste management. They are informed by legislative frameworks and research undertaken at the Level of Production. The material designers managed to recontextualise the knowledges suggested by legal frameworks and the specialists in the field of production and in the qualifications, but also changed this knowledge in particular ways, especially by placing more emphasis on propositional, procedural, and technical knowledge, as shown in Table 5.8 above. Also included is knowledge showing the impacts of the people, which I call social knowledge, but this is a different emphasis to that which is proposed in the Unit Standard (i.e. it emphasises broader social responsibility and offers less emphasis on workers' immediate well-being and values). What is missing in this module is the organisational planning and management knowledge as well as more locally relevant economic knowledge, both of which could be of potential benefit to workers who are in part-time employment in the EPWP system.

Considering these findings associated with the recontextualisation of knowledge from the Official Recontextualising Field to the Professional Recontextualising Field using Maton's specialisation dimension, shows that P1's materials demonstrate that the knowledge code privileges specialisation (ER+) within the waste management learning programme materials at NQF level 2. The social relation is not strongly legitimated and the social relation is therefore weaker (SR-).

5.3.3 Recontextualision of knowledge in the case of Provider Two (P2)

In the next section, the contents of the learning material produced by Provider Two (P2) is compared with the contents of the Unit Standard to identify how the knowledge has been recontextualised into the learning programme. This analysis, represented in Table 5.10 below, is summatively developed from a more detailed analysis thereof contained in Appendix 13.

Table 5.10: Summative comparative analysis of knowledge included in Unit Standard 119555 and the learning programme developed/utilised for training by Provider 2 (see Appendix 13 for more detail)

	Unit standard prescription		**Learning programme indication** *significant differences to the US are indicated in italics* (page references are to pages in the materials)
US title	**Separate, handle, store, treat and transport waste**	**US title**	**Separate, handle, store, treat and transport waste**
Purpose	• Know and understand principles and concepts related to waste	**Know and understand**	**Know and understand:** • Principles and concepts related to waste management and their application in practice

	management and their application into practice • Methods of handling and transporting waste • Classify separate, treat, store and transport waste responsibly and in compliance with legislation • Control, access and monitor the flow of incoming materials to a waste facility		• Methods of handling and transporting waste **be able to:** • Classify, separate, treat, store and transport waste safely, responsibly and in compliance with legislation • Control access and monitor the flow of incoming materials to a waste handling facility (p.22)
Specific Outcomes	SO 1: Separate, treat and store waste SO 2: Transport Waste SO 3: Control, access and monitor the flow of incoming materials to a waste facility SO 4: Recognise and report threats or damage to health safety or the environment SO 5: Compile relevant records	**Specific Outcomes**	• *Classify,* separate, *handle,* treat, store, *transport* and *dispose* waste correctly, safely, responsibly *and in compliance with legislation. (combines SO1 and SO2, with further detail from the purpose statement of the US)* • Control, access and monitor the flow of incoming materials to a waste facility • Recognise and report threats or damage to health, safety or the environment • Compile relevant records
	Specific outcomes in Unit Standard 119555		**Specific outcomes content knowledge as found in P2's materials**
	SO 1: Separate, treat and store waste: *As noted in Table 5.3 and 5.4 the content associated with this unit standard focussed on categories, and handing methods, as well as safety of workers, equipment, materials and the environment as well as incident management. Overall the propositional, procedural and technical knowledge dimensions of the content associated with this unit standard were under-specified.*	**Activity 1 (pp. 22- 24)**	**Separate, treat and store waste** The content under this SO is divided into two subsections 1. Separate and treat waste • Discussed separating and treating of waste in relation to the bylaws of the area. They are quoted below and written in italics: • *Recyclable material for the purpose of recycling must not be stored at any premise resulting in risks or nuisance conditions* • *Separation of waste or sorting of recyclables shall be performed on the premises, of the point of generation of the recyclable waste stream* • *All facilities where separation and classification are done must comply with the statutory requirements* • *Glass and other recyclables are normally not collected by the RSA municipalities* • *Glass must normally be taken to glass recycling banks* • *Composting of organic waste* 2. Store waste *Commence by discussing the Specifications for storage areas:* • *Criteria established for areas where waste is stored in terms of the following:* • *Floors, roofs and walls*

			• *Ventilation and lighting* • *Water supply and drainage* • *Access of vehicles to storage areas* • *Compaction equipment* • *Screening and security* • *Bylaws established where waste is stored* • *Typical municipal requirements* • Different ways in which waste is stored *The P2 is providing greater specification of procedural and technical knowledge in relation to the learning outcome, with less emphasis on propositional knowledge. P2 also applies the regional legislations guiding the procedures and technical knowledge. Time and again he makes reference to the prescriptions determined by the bylaws*
	SO 2: Transport Waste *Here the knowledge specification is related to on-site movement of waste, with emphasis on quality standards, health and safety, and incidents management. It also makes reference to how it is loaded and offloaded using safe and correct techniques and safe working clothes in safe working environments*	**Activity 2 (pp. 31 – 35)**	Waste is loaded, moved, offloaded and positioned efficiently and as required. • Operations are carried out to quality standards efficiently and safely • Work is carried out safely and with due care for self, fellow workers, equipment, materials and the environment. • Incidents and problems are reported timeously and appropriate action is taken • *Domestic waste transportation* • *Explain at length the structure of the different vehicles used for transporting waste* • *Different types of vehicles used for transportation e.g. rear end loader and lift –on or load lugger vehicle* • *Things to be kept in mind while selecting vehicles* *Here P2 is providing contextual interpretation into the domestic waste management stream. Explaining the how waste is loaded and offloaded from the different types of vehicles. Show pictures of the different types of vehicles used to transport waste.*
	SO 3: Control access and monitor the flow of incoming materials to a waste facility *Here knowledge specification is related to on-site organisational procedures, recognition of non-compliance, appropriate response, and security of the facility.*	**Activity 3 (pp. 39 – 40)**	Minimum requirements for the disposal of waste • *Sign in to the waste facility in appropriate languages* • *General notices at the entrance of the landfill* • *The class of the landfill and the types of waste accepted* • Waste that cannot be accepted must be stated • There should be a visible signpost warning about the associated hazards Waste Acceptance • *Waste should be received where it is supposed to be deposited* • *Each to be deposited in a facility designed for it* • *It must be inspected prior to disposal by suitably qualified staff* Access to control

			• *Procedures and access to the site must be controlled* • *There should be a single controlled entrance to prevent unauthorised dumping* • *The gate should be lockable* *Collection of disposal tariffs* • *Tariffs are levied and collected at all waste facilities* • *Tariffs should be displayed at all notice boards* Security • Suitable security should be provided to protect the facility *Here P2 is elaborating on the technical and procedural knowledge related to controlling and managing the flow of waste into a waste facility; emphasising the landfill as the particular facility (i.e. also contextualising the knowledge)*
	SO 4: Recognise and report threats or damage to health, safety of the environment *Here the knowledge specification relates to preventative, corrective and remedial actions relevant to people and the environment. It also make reference to dangers to health and safety of the people and the environment.*	**Activity 4 (pp. 41- 43)**	Recognise and report threats or damage to health, safety of the environment • *Potential dangers to health, safety and the environment which can arise during the processes of handling, separating, treating, storing and transporting waste are identified and described accurately and appropriately.* • *Measures which can be taken to prevent, correct, or remedy threats or damage to health, safety, or the environment are explained correctly* • *Every facility should have a response action plan which provides detail of procedures to be followed in case of accidents, emergencies, failures in the design or operation* • *All failure modes and effects must be quantified in a risk assessment and onsite and offsite emergency plans developed* *Nuisances and mishaps on the facility need to be avoided, for example:* • *Burning of waste in facilities is prohibited* • *Litter should be contained within the facility* • *Noise must be kept within accepted noise controls* • *Waste sites must be kept free from vermin* • *Uncontrolled separation by unauthorised people should be avoided* *Here P2 is elaborating on the technical and procedural knowledge relevant to health and safety aspects of waste management. Again the context appears to be domestic waste management and a landfill facility.*

	SO 5: Compile relevant records *Here the knowledge specifications relate to incident reporting, site-based regulations, and health and safety.*	**Activity 5 (pp. 43 -45)**	Compile relevant records • Records are completed accurately, up to date and processed correctly • *Waste site operators, facility users and the Department of Environmental Affairs all require waste recording for commercial purposes, record keeping for site management and control.* List of key activities that require recording • *Gate or weighbridge recording procedures: The method of waste recording must be appropriate to the nature and the volume of the waste entering the site* • *Any facility stream requires recording of the type and the volume or mass of material separated including for garden waste processing and handling of special waste* • *Equipment and resource use* • *Safety, health and security* • *Weather: Waste disposal facilities require weather recording for planning and control purposes.* • *Accidents, incidents and emergencies: Records of all incidents at a waste facility must be compiled and kept for future use and reference.* *Here P2 again elaborates on the knowledge specifications in relation to the context of domestic/solid waste management in a landfill site context.*

In the next table, Table 5.11, I summarise the types of knowledge identified in Provider 2's materials. All the units of P2's Module 1, namely sections 1-5, were read through and analysed. I identified the types of knowledge per unit. The full analysis of this is contained in Appendix 14. Here I offer a summative version showing examples of the different types of knowledge from the empirical data, as well as a summative comment of what was included and excluded as this helps to establish what knowledge was foregrounded in the module.

Table 5.11: Summative view of types of knowledge emphasised in Module 1 and with some illustrative empirical examples identified in the materials of Provider 2 (see Appendix 14 for further in-depth analysis)

TYPES OF KNOWLEDGE (see Tables 5.4 & 5.5)	EMPHASIS ON & INDICATOR	EXAMPLES FROM P2's materials	COMMENT ON P2's MODULE CONTENTS OVERALL (see Appendix 14) – considered in relation to Table 5.3 and 5.4 above, as well as Table 5.9.
Propositional knowledge Emphasised in SO 1	Knowledge what / specialist knowledge in the field Indicator: types and names of waste, categories, definitions	Concepts introduced: Recycling Domestic waste Landfills	• As shown in Table 5.9 above, P2 did not give much attention to propositional knowledge. However, propositional knowledge was introduced via the procedural and technical knowledge. • Did not explain concepts individually and independent from the context • Included discussion of treatment and separation waste in relation to the bylaws of the region and the metro. • They are quoted below and written in italics: • *People involved in recycling must comply with all applicable statutory requirements.* • *Separation of waste or sorting of recyclables shall be performed on the premises, of the point of generation of the recyclable waste stream*
Procedural knowledge Emphasised in SO 1, 2, 3, 4, 5	Knowledge how procedures, processes, techniques and skills) Indicator: Waste management from the point of generation to the point of disposal.	Discuss how waste is loaded, moved, offloaded and positioned efficiently and as required during transportation of waste Discuss how waste is stored, show different types of bins and how refuse bins are stored It also indicates how storage areas need to be planned. They should be away from residents to eliminate noise and odours Different storage containers are displayed by means of pictures For disposal facilities, suitable signs must also be erected on site to direct vehicle drivers appropriately and to control speed. A general notice board must be erected at the site entrance.	As show in Table 5.9 above, procedural knowledge was emphasised in the P2 materials, especially related to domestic waste management and landfills as the main waste management facility associated with this type of waste management. The contextualisation of the waste management type and site therefore influenced the selection of the procedural knowledge. Include how waste is loaded, moved, offloaded and positioned efficiently and as required during transportation of waste They include the regional legal frameworks guiding the techniques and processes as well as issues of health and safety for the people They include and give different examples of vehicles and show by means of pictures how they load and offload the waste *structure of the different vehicles used for transporting waste.* *Different types of vehicles used for transportation e.g. rear end loader and lift –on or load lugger* Excludes explanation of waste hierarchy, which is inclusive of the processes like treatment, waste avoidance and others.
Technical knowledge	Pertain to technical	Handling of special waste:	As show in Table 5.9 above, technical knowledge was emphasised in the P2

Emphasised in SO 1, 2, 3, 4, 5	skills. Waste management is inclusive of a theory part and practice Indicator:	Special waste received include standard household chemicals and containers used batteries and other electronic equipment like old cell phones and remotes, household appliances and used computers, used machines and equipment.	materials, especially related to domestic waste management and landfills as the main waste management facility associated with this type of waste management. The contextualisation of the waste management type and site therefore influenced the selection of the technical knowledge. Include: Minimum requirements for the disposal of waste *How people can be assisted to know location of disposal facilities as well as the procedures informed by legislation to deal with waste in the facilities* *e.g. Signs erected in to the waste facilities in appropriate languages* *General notices at the entrance of the landfill* Included procedures of accepting waste in the facilities e.g. • *Each to be deposited in a facility designed for it* • *It must be inspected prior to disposal by suitably qualified staff* *Procedures of how access to the site must be controlled e.g.* • *There should be a single controlled entrance to prevent unauthorised dumping* • *The gate should be lockable* *Ways in which special waste is handled e.g batteries, electronic equipment household appliances and used computers discussed.* Security • Suitable security should be provided to protect the facility
Institutional planning and management knowledge Emphasised in SO3 and SO5		Waste site operators, facility users and the Department of Environmental Affairs all require waste records for different reasons Records are also necessary for the site (p. 43- 45)	As shown in Table 5.9 above, institutional planning and management knowledge was emphasised in the P2 materials, especially related to domestic waste management and landfills as the main waste management facility associated with this type of waste management. The contextualisation of the waste management type and site therefore influenced the selection of the institutional planning and management knowledge. *It includes measures which can be taken to prevent, correct, or remedy threats or damage to health, safety, or the environment are explained correctly e.g* • *Every facility should have a response action plan which provides detail of procedures to be followed in case of accidents, emergencies, failures in the design or operation.*

			• *All failure modes and effects must be quantified in a risk assessment and onsite and offsite emergency plans developed.* *Nuisances and mishaps on the facility need to be avoided, for example:* • *Burning of waste in facilities is prohibited* • *Litter should be contained within the facility* • *Noise must be kept within accepted noise controls* • *Waste sites must be kept free from vermin* • *Uncontrolled separation by unauthorised people should be avoided*
Economic knowledge Not emphasised in any of the SOs	Pertaining to money, fund raising and job creation issues Indicator: Issues related to economics or money matters	In most cases, waste disposal tariffs are levied and collected at all waste facilities. Tariffs should be displayed on the notice board. They should be based on the mass where a weighbridge exists, on estimated volumes.	As reflected in Table 5.9 and Appendix 14 the focus of economic knowledge was related to the waste management tariffs, as relevant to the technical and procedural aspects of processing of waste on site. They include the *Collection of disposal tariffs* • *Tariffs are levied and collected at all waste facilities* • *Tariffs should be displayed at all notice boards* Security : Suitable security should be provided to protect the facility They excluded economic information related to economic benefits of recycling
Social knowledge Emphasised in SO 4	Pertain to influences of people Indicator: values, human well-being, safety of workers and environment	Any visitor entering a restricted area must be stopped for the safety and security of the visitor and of the organisation (p. 46) Employees should make sure that visitors do not enter prohibited, high security and dangerous areas Visitors should not pick stuff from the facilities	As noted in Table 5.10 above, mainly social knowledge related to health and safety of workers and visitors is emphasised. It includes security and safety of the facilities. It includes how people should ensure security and safety in the waste facilities
Legal knowledge Implied in SO 1, 2, 3, 4, 5 but not explicitly emphasised	Pertaining to policy and legal frameworks in waste Indicator: Knowledge from legal documents	Materials are allowed to enter the site in accordance with organisational processes Non-compliant waste is recognised and appropriate action is taken It must be stated that disposal of non-	As noted in Table 5.10 above, the focus of legislative knowledge shared in the P2 materials was related to compliance associated with the management of waste in the context of landfill sites. There was also an emphasis on local legislative knowledge, especially related to bylaws and how they were used to manage waste and set standards. National legislation was less emphasised.

	and issues of compliance and non-compliance	acceptable waste types is illegal and can lead to prosecution. (p. 40)	
Historical knowledge Not emphasised in SOs	History of how waste management has changed over time	Not included	Not included

From the analyses presented above in Tables 5.10 and 5.11, and like in the case of P1 reported on above, it is clear that the providers *have* taken up the responsibility that is left to them by the under-specification of content in relation to the outcome statements (reported on in Table 5.3, 5.4 and 5.6 in section 5.2 above). In the case of P2, the provider tended to stick very closely to the prescriptions of the Unit Standards, but also effected some changes or expansions in interpretation in the recontextualisation process as shown in Tables 5.10 and 5.11. As in the case of P1, the materials designers' recontextualisation has two perspectives. There is evidence that the materials designers are recontextualising knowledge from both the Field of Production and the qualification specifications found in the unit standard. There is also evidence that they are selectively appropriating knowledge and ideologically transforming it. These two perspectives will be discussed in more detail below.

As shown across this chapter, Unit Standard 119555 has five outcomes, which are listed in Table 5.10. Provider 2 has utilised as outcomes for its materials all the outcomes suggested by the Unit Standard and has produced a closely 'matched' curriculum in which the programme is divided into five sessions, where each session is based on a specific outcome from the Unit Standard. Each specific outcome session is broken down into sub-sections, which mediate and introduce *context specific* content which emphasises domestic waste management using landfill sites as the main facility as noted in Table 5.10 above.

Specific outcome 1 which reads: "separate, treat, and store waste has been broken down into two sub-sections "separate and treat" and "store waste". Provider 2 has recontextualised this specific outcome to include only a few aspects of the waste hierarchy, namely issues of recycling, and storage of waste. Provider 2 did not include all spheres of government but focussed more locally, specifically on waste management in urban residential areas. From the onset, he refers to activities as suggested by the bylaws of a metro nearby. As the discussion is based on the bylaws of this metro the focus is therefore on how waste needs to be separated

and stored in an urban residential area. It would be difficult for learners in a rural town to apply this information in their rural settings. What has been excluded from this context specific recontextualisation are issues of treating waste.

Specific outcome 2 is "Transport waste". In this section, Provider 2 discusses how waste is stored and safely loaded and offloaded from vehicles, again confining the recontextualisation to the specific waste stream and context. The different types of storage containers are listed with pictures. The different types of transport used in the transport of waste are explained and examples and drawings are given (see extract from the P2 materials below).

SEPARATE, HANDLE, STORE,
TREAT and TRANSPORT WASTE

ANDTRANSPORT WASTE

1.1 ACTIVITY 1: SEPARATE, TREAT AND STORE WASTE

1.1.1 Separate and Treat Waste

The following is a direct quote from the bylaws of the Tshwane Metro dealing with recycling. Most municipalities have similar clauses in their by-laws.

"27(1) Recyclable material for the purpose of recycling must not be stored at any premises resulting in risks or nuisance conditions;
(2) A person involved in any way in recycling, must comply with all applicable statutory requirements;
(3) Separation of waste or sorting of recyclables shall be performed on the premises of the point of generation of the recyclable waste stream;
(4) All facilities where separation and classification of recyclable material is performed, must comply with the applicable statutory requirements."

Glass recycling

Glass and other recyclables are normally not collected by the RSA municipalities as part of the domestic waste and recyclable materials collection service and must be normally be taken to glass recycling banks.

Developers of flats, apartments and sheltered housing schemes, where communal waste storage facilities are installed, are normally encouraged to make additional provision within the bin storage area to accommodate three bins for clear, green and brown glass. Careful consideration should be given to the positioning and screening of glass recycling facilities to ensure that noise and disturbance is minimised.

The appropriate positioning of a composting bin for grass cuttings and chipped woody material to provide compost for re-use on site would save transport and disposal costs for grounds maintenance contractors.

1.1.2 Store Waste

Typical specifications for refuse storage areas at multiple dwellings and commercial premises

The following represents some criteria that may be applied to the establishment of areas where waste is stored at domestic and commercial premises pending removal by the service provider.

Floor

The floor shall be concrete, screened to a smooth surface and rounded to a height of 75mm around the perimeter. The floor shall be graded and drained to a floor trap.

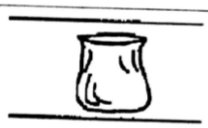
Walls and Roof

The Waste/Recycling storage area/room shall be roofed to prevent any rainwater from entering. The walls shall be constructed of brick, concrete or similar and painted with light colour high gloss enamel, or alternatively, tiled with tiles of a light colour. The height of the room to the ceiling shal be not less than 2.21 metres.

Ventilation and Lighting

Selection of onsite storage systems for waste

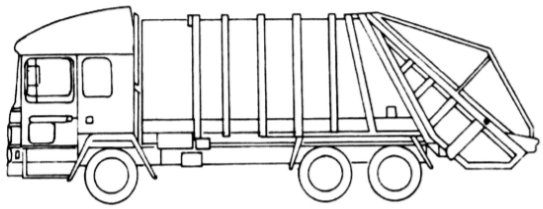
The following table show options for waste storage and containment on site.

CONTAINERSS FOR ON-SITE STORAGE SYSTEMS			
DESCRIPTION OF WAYS THAT WASTE CAN BE STORED	**COMMON USAGE**	**PICTURE**	**COLLECTION METHODS**
85 litre plastic bin liners (practical limit: 10 kg or 50 litres)	Domestic/household, small business & industry General public facilities.		By hand on-site or on sidewalk, full bags deposited directly into collection vehicle.
85 litre plastic/ rubber/galvanised steel bins (practical limit on hot ash, acids and chemicals depending on material container is made of)	Domestic/household small business & industry. General public facilities		By hand on-site or on sidewalk; Contents deposited directly into collection vehicle.
120/240 litre mobile refuse bins	Domestic/household small business & industry. General public		Rear-end-loading compactors with special lifting equipment.

1.2 ACTIVITY 2: TRANSPORT WASTE

1.2.1 DOMESTIC WASTE TRANSPORTATION

1.2.1.1 The Rear- end-loader (REL)



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This vehicle comes in various configurations, differing in capacity of body ranging from 11 m3 to 21 m3. The smaller vehicles are equipped with single rear axles and from about 16 m3, depending on road traffic regulations a second rear axle is needed to carry the excess weight. The design of the vehicle with the large rear overhang often results in overloading on the rear axles, especially when relatively empty.

Waste is loaded from the rear and compacted by a single or set of blades against the ejector blade which is a vertical blade in the loading area connected to a hydraulic ram that is used to eject the waste from the full vehicle.

When loading, the ejector blade is pushed fully to the back. The compaction mechanism – also hydraulic – sweeps the waste from the loading hopper into the body and compacts it against the ejector blade. When a certain hydraulic resistance is achieved, the ejector blade automatically moves back to allow more waste to be loaded until the total load bin is full. In this way, the loose volume of the waste is reduced, depending on the type of waste, by a factor of up to five to one.

1.3 ACTIVITY 3: CONTROL ACCESS AND MONITOR THE FLOW OF INCOMING MATERIALS TO A WASTE FACILITY

The control of waste at waste facilities is prescribed in many ways by the Minimum Requirements for the disposal of waste by landfill. The following are some of the appropriate measures that must be adhered too:

1.3.1 SIGNPOSTING AND ROAD ACCESS

Signs in the appropriate official languages must be erected in the vicinity of the any waste facility, indicating the route and distance to the landfill site from the nearest main roads. These traffic signs must conform to the requirements of the Road Ordinance. Suitable signs must also be erected on site, to direct vehicle drivers appropriately and to control speed.

A general notice board must be erected at the site entrance. This must also be in the appropriate official languages, stating the names, addresses and telephone numbers of the Permit Holder and the Responsible Person, the hours of operation, and an emergency telephone number. It is of particular importance that the sign clearly states the class of landfill and the types of waste that can be accepted.

Wastes that cannot be accepted must also be stated. It must be stated that disposal of non-acceptable waste types is illegal and can lead to prosecution. In the case of hazardous waste landfills, clearly visible signposts warning of the associated hazards must be erected along the fence line at intervals not exceeding 100m.

1.3.2 WASTE ACCEPTANCE

One purposes of classification of waste facilities is to ensure that general waste is only received at sites suitable for such material and that any problematic material or hazardous waste is disposed of only on sites and facilities specifically designed and developed for hazardous material.

Prior to waste being accepted at general waste disposal facilities, it must be inspected by suitably

In specific outcome 3, the control, access and monitoring of the flow of incoming materials to a waste facility is discussed at length. The discussion in this column explains the activities in a well-established licensed waste facility (namely a landfill site). In South Africa the waste baseline (South Africa. DST, 2011) indicated that there are few licensed landfill sites in the country. What is discussed is therefore largely 'foreign' or 'abstract' especially in the context of rural municipalities where few functioning landfills exist. Thus, while the recontextualisation is focussed on domestic waste and landfill management, the contextualisation does not extend to the broader reality in the country. Seen from another perspective, it is useful to the learners as it exposes the learners to the ideal situation which is or may be absent in their rural towns, offering them the possibility for critical analysis and engagement. In these materials a perfect urban waste management facility, its contents and procedural functionings are recontextualised into P2's materials. Extracts from Units from 4 and 5 can be found below

1.4 ACTIVITY 4: RECOGNISE AND REPORT THREATS OR DAMAGE TO HEALTH, SAFETY OR THE ENVIRONMENT

Every waste facility is operated in accordance with an Operating plan which is supplemented by a Response Action Plan. The operating plan is developed in accordance with stipulations and rules contained in the operational permit for the site. The operational permit is clear and specific regarding the types and classes of material that may be accepted at the specific facility. It is also clear and specific regarding allowable processes and procedures for the operation of the facility.

The Response Action Plan provides detail of procedures to be followed in case of accidents, emergencies, failure in the design or operation. It also includes an emergency evacuation plan.

All failure modes and effects must be quantified in a risk assessment and on-site and offsite emergency plans developed. These plans require evacuation drills and staff must be familiar with the different plans and drills for each of these plans. Military precision is required for these plans and no deviation should be allowed. Training of staff and practice drills of procedures is of core importance to ensure that all staff knows exactly what to do in case of emergencies.

1.4.1 CONTROL OF NUISANCES

Any facility that receives waste material will experience mishaps and this will result in nuisances. These should however be the exception and not the rule. With accidents and similar incidents nuisances may be more frequent and procedures to handle these are required. Nuisances resulting from the operation should be controlled as follows:

1.4.1.1 Burning of waste

The burning of waste is considered unacceptable because of aesthetics, odours and the potential of health dangers from air pollution. On account of these adverse impacts, the burning of waste at waste facilities is prohibited; this should be applied to all areas and activities where waste occurs, is generated or is handled. The only exception should be controlled burning through proper incineration or other heat treatment processes. Accidental fires on waste facilities must be

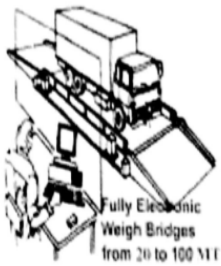
1.5 ACTIVITY 5: COMPILE RELEVANT RECORDS

Waste site operators, facility users and the Department of Environmental Affairs and Tourism all require waste records for different reasons. Over and above the measurement of incoming waste for commercial purposes, records are also necessary for site management and control. Normal

business requirements also require that records of waste process and related activities be generated and maintained. The following is a list of key activities that require recording.

Gate or weighbridge recording procedures

A primary source of information is the entrance gate or weighbridge. The method of waste recording must be appropriate to the nature and the volume of the wastes entering the site. Such data bases are sometimes termed 'dynamic records'. The degree of sophistication required will be dependent on the class of site involved. In general, however, records must be kept of all waste entering the site.



Weighbridges are expensive and costly to operate and are normally only introduced for sites and facilities where large volumes of waste are received. For smaller facilities, volume control is adequate, but then the volumes must be as accurate as is practical possible, like measuring the size of a load rather than estimating the size. Waste must be categorised by the number of loads (defined by volume or mass), the type of waste and the source.

Material separation

Any facility were material is separated from the waste stream requires recording of the type and

In specific outcome 4 recognition and reporting of threats, damage to health and safety of the environment, which can arise during the processes of handling, separating, treating, storing and transporting waste are identified, and described accurately and appropriately. The examples of nuisances that need to be avoided are listed and discussed. Nuisances are described as results of mishaps in facilities that receives and stores waste material.

In specific outcome 5 "how to record" is discussed as well as examples of what needs to be recorded in waste facilities. This information and process is prescribed by the Department of Environmental Affairs and site managers. All require waste records for the measurement of incoming waste for commercial purposes, site management and control. The providers who leave this out (e.g. P1) are absenting a critical element of waste management in municipalities. This has been recognised by Godfrey (2008) who conducted research on the importance of a waste information system framework for a developing country like South Africa. She indicated that information systems are needed for planning, decision-making, communication, implementation, monitoring and review of waste management processes. As discussed above,

absence of such content also limits what learners can learn about the context of formal employment in the waste management sector.

Table 5.11 reflects further on this and identifies that P2 also gave attention to most of the forms of knowledge that were identified in the Field of Production, again with emphasis of contextualisation to one particular type of waste management stream and facility. Table 5.11 shows that Provider 2's materials contain a mix of propositional, legislative, economic, procedural, technical, institutional planning and management and social knowledge. Historical knowledge is absent as in P1. The propositional, legislative, economic, procedural, technical and institutional management knowledge display mainly specialist knowledge, skills, procedures and processes in waste management. They are informed by processes of knowledge construction in the Field of Production, as also discussed above. The P2 materials designer managed to recontextualise all the types of knowledge emphasised in the Field of Production, except historical knowledge, which is also not emphasised in the Unit Standard. This shows strong framing (F+) in relation to the Field of Production and the Official Recontextualisation Field, and also strong classification (C+) where knowledge is insulated from the everyday knowledge of workers who have little or no inputs into the design of the P2 materials and programmes. In the case of P2, the contextualisation of the knowledge from the Field of Production to one specific waste management stream and context shows the selective appropriation and ideological transformations effected by P2, which was towards efficient waste management in an urban setting using a well-functioning landfill system approach, and a local compliance emphasis. This shows a weakening of the framing (F to F-) from the full scope of waste management knowledge in the Field of Production and Official Recontextualising Field to a small selection of knowledge from the full scope of the waste hierarchy, applied to one specific contextualised stream of waste management knowledge which has been judged by P2 to be most appropriate for the EPWP training setting. Interpreting this from Maton's theory of specialisation, the epistemic relation is strong (ER+) in the P2 materials as specialist knowledge, even when contextually applied, is emphasised over social and everyday knowledge of learners, making the social relation weak (SR-).

5.3.4 Discussion of the recontextualisation of knowledge in providers' materials

As can be seen from the analysis above, the two providers used the same qualification and unit standard but they recontextualised their learning programmes differently. Their learning programmes, though they originate from the same unit standard, are diverse. One used all the

specific outcomes while the other left out some of the specific outcomes prescribed by the qualification in this unit standard. They have applied the content knowledge differently and have applied it differently to waste management contexts. Provider 1 emphasises propositional knowledge more than Provider 2, offering a wider range of more generic waste management information relevant to a wider scope interpretation of the waste hierarchy and associated technical methods and procedures. Provider 2 on the other hand, uses a smaller range of propositional knowledge from a limited selection of the waste hierarchy, and applies the procedural, technical and institutional and management knowledge in an urban waste management context focussing mainly on the domestic waste stream. Provider 2 has recontextualised the content knowledge as requested in unit standards 119555 of the environmental practice qualification, which seeks providers to apply the knowledge to particular waste management contexts.

As outlined above, in both cases, using Bernstein's sociological analytical tools, framing is strong (F+) between the Field of Production, the Official Recontextualising Field and the Professional Recontextualising Field. There is a slight weakening of framing that occurs as providers selectively appropriate and ideologically transform knowledge, a factor that appears to be influenced by their perceptions of what would be most relevant for the EPWP workers. Classification is also strong (C+).

As noted above, the learning materials of P1 and P2 contain a considerable amount of waste management specialist knowledge, which includes the names of waste types and categories, the waste hierarchy, procedures and techniques of waste management and waste management prevention. Procedures and processes from separation, sorting, recycling, and storage to disposal are well articulated in the learning programmes. The controls, and waste recordings are well articulated in Provider 2's learning programme but are absent in Provider 1's. Legislative knowledge is included in both: in Provider 1 national legislation is included and emphasised, while in Provider 2's case local and organisational legislation is included and emphasised. In both cases, aspects of social knowledge are included and limited aspects of economic knowledge. Technical knowledge, legal knowledge, economic knowledge, social knowledge and planning and management knowledge have therefore been recontextualised, albeit it in different ways. Overall, in both cases, using Maton's analytical tool of specialisation, the epistemic relation is strong as specialist knowledge is privileged (ER+), and the social relation is weak (SR-), as workers and learners have little contribution to make to the framing

of the learning programmes in either P1 or P2's case. The findings from the providers' materials therefore indicate that the knowledge code (ER+) has been recontextualised into the Official and the Professional Recontextualising Fields. This knowledge code legitimates specialisation, which determines the basis of achievement within the waste management learning materials while the social relations SR- are weaker and downplayed. Of interest though is the way in which certain aspects of specialised knowledge that may be of benefit to social transformation of the workers' conditions and well-being (outside of their chance to obtain specialist knowledge via the EPWP training programmes) such as economic knowledge relevant to their wider participation in the waste economy and historical knowledge which could create a more inclusive context for cultural knowledge related to waste management, and political engagement in waste social movements are excluded. This occurs in the recontextualisation from the Field of Production where such knowledge is available (see Table 4.1), to the Official Field of Recontextualisation where the Unit Standard is developed, and from here these absences are reproduced in the Official Recontextualising Field.

5.4 CONCLUSION

In this chapter the recontextualisation of waste management knowledge is explored from the Field of Production into the Official Recontextualsing Field where waste management qualifications and skills programmes are designed and then into the Professional Recontextualsing Field where learning programmes and learning materials are developed by training providers. The focus has been on Level 2 of the National Qualifications Framework for the EPWP programme focussing on Waste Management qualifications, and one Unit Standard in particular as this is a strong 'carrier' of waste management knowledge and is central to the EPWP skills programmes. The analysis used one of the explanatory tools used in Bernstein's pedagogic device, which helps to analyse how knowledge is decoded, selectively appropriated, ideologically transformed and relocated, involving processes such as re-interpretation, inclusion and exclusion, contextual interpretation and simplification. This chapter has shown the recontextualisation process to the level of materials design of two providers who offer EPWP training. The analysis shows strong framing (F+), strong classification (C+) and a strong epistemic relation (ER+) which is recontextualised from the Field of Production through to the Professional Recontextualising Field, with some significant absences also being re-produced in the recontextualisation process. In the next chapter, I further examine the recontextualisation process, this time at the level of actual training experiences of workers.

Chapter 6:

Waste Management Knowledge of Workers in the Project

6.1 INTRODUCTION

This chapter is the fourth of the five chapters that report on the findings of this research. Unlike Chapters 3 and 4, which focussed on the knowledge in the Field of Production and the Official and Pedagogical Recontextualisation Fields, this chapter focusses on the waste management knowledge and the experiences that workers bring to the project. As such, its purpose is to develop a more in-depth understanding of the workers who participate in the training that is planned for them in the Official and Pedagogical Recontextualisation Fields. In the next chapter, Chapter 7, I return to the Pedagogical Recontextualisation Field, where the training planned for by Provider 1 for the EPWP skills programmes is reviewed in detail. First, I thought it is best to develop a stronger insight into the knowledge of the workers, to better comment on and analyse the actual training processes, hence this chapter is positioned before Chapter 7.

This exploration is intended to provide insight into how the flow of information or circulation of knowledge manifests itself through the activities of the project. As indicated in Chapter 1, this research is conducted in EPWP projects. It is envisaged through the policies of EPWP that participation in the activities and training programmes of the projects will improve the present and the future status of the workers and the environment in which the programmes are implemented. While that is the case, and as reflected on in Chapter 1, I noted that sometimes at the end of the projects, things do not happen as planned. This chapter therefore investigates whether there is any connection between workers' knowledge and life experiences they bring from home and school and the EPWP projects, which influence the circulation of knowledge from the Field of Production as outlined in the previous two chapters.

Circulation refers to the flow of knowledge between and amongst all the participants in the project whether it is formal or informal. In this chapter, I concentrate on the circulation of knowledge through examining the dispositions and the experiences that the workers bring to the project. I also look into the pedagogy of workplace learning interactions and the underlying principles structuring this knowledge and practice. This chapter seeks therefore to partly answer the following research question:

- How does waste management knowledge circulate amongst the workers? What do the workers bring from home, which influences workplace or project activities?

Maton (2010) noted that knowledge is "structured and structuring". It is structured both because it is a result of previous activities and experiences of people and it is structured in certain ways (e.g. via disciplines or unit standards) to assist others to learn. Taking this 'dual' nature of the structuring of knowledge into consideration, I commenced by enquiring whether and how the knowledge and behaviours of the workers in the projects were related to their previous activities and actions, as I have already given attention to how knowledge is structured out of the Field of Production and Official and Pedagogical Recontextualising Fields (Chapters 4 and 5). I tried to focus on and explore waste management knowledge that workers acquired and bring from home, from their schooling and through their participation in project activities, and lastly I explored what they had learned through the training activities. The circulation of knowledge in the project (informal) as well as circulation through training (formal interactions) are addressed in the next chapter (Chapter 7).

The data that I draw on in this chapter was collected through a first layer of interviews, which was conducted three weeks after the project started while the second layer was conducted after seven months of the implementation of the projects. The second layer of interview data is used in the next chapter as it focusses more on their learning via the EPWP training programmes. The first layer of interviews were aimed at exploring the waste management knowledge workers brought into the project prior to being part of the training.

Interviews were held with workers in two projects implementing the same type of activities. The two projects are implemented in two rural towns in the Eastern Cape. The first section of the interview schedule focussed on the biographical data of the workers, which consisted of questions around their places of birth, qualifications and activities/job in the EPWP project. The second section focussed on what they considered as waste in their homes and how they managed this waste. The third section focussed on what they considered as waste in their previous schools and how this was managed at the school. The fourth section focussed on what they considered as waste in the EPWP project and how this was managed in the project in the time since they had joined the EPWP project. Six workers were proposed by the project managers per project to participate in the interviews and they were requested to give their consent to be part of the interviews after the purpose of the interviews was carefully explained to them. All were given the option not to participate in the interviews and it was agreed with

the project managers that if the above were to happen then other nominees would be sought. Their biographical details are given below but pseudonyms were used to protect the identities of the participants, as was agreed at the start of the interviews.

Table 6.1: Biographical data of participants in Project 1 (names are pseudonyms)

Name	Gender	Rural/ urban	Level of education	School zone	Previous job	Present job
Cawekazi	Female	Rural	Grade 12	Rural	Cleaning in Ntsika- Yethu Municipality for 3 months	Litter-picking and street cleaning (EPWP)
Luma	Male	Rural	Grade 12	Rural	None	Litter-picking and street cleaning (EPWP)
Love	Male	Rural	Grade 12	Rural	Worked as a cleaner in Pelopepa Health Train	Litter-picking and street cleaning (EPWP)
Happy	Male	Rural	Grade 12	Rural	Cleaned aeroplanes in Cape Town	Litter-picking and street cleaning (EPWP)
Andisiwe	Female	Rural	Grade 8	Rural	Worked in the municipality for 3 months – cleaning waste	Litter-picking and street cleaning (EPWP)
Sindi	Female	Rural	Grade 11	Rural	Worked in furniture shop	Litter-picking and street cleaning (EPWP)

Table 6.2: Biographical data of participants in Project 2 (names are pseudonyms)

Name	Gender	Rural/ urban	Level of education	School zone	Previous job	Present job
Abongi	Male	Rural	Grade 9	Urban	Cleaning, scrubbing and braaiing [barbecue] meat in Durban	Litter-picking and street cleaning (EPWP)
Khaya	Male	Rural	Tertiary institution /	Urban	Intern Department of Education	Litter-picking and street cleaning (EPWP)
Lizo	Male	Rural	Grade 8	Rural	Security	Litter-picking and street cleaning (EPWP)
Mfana	Male	Rural	Grade 11	Rural	Building and motor- mechanic in Mpumalanga	Litter-picking and street cleaning (EPWP)
Sanda	Female	Rural	Grade 11	Rural	Removing paint on old cars – three week contract	Litter-picking and street cleaning (EPWP)

Bongi	Male	Rural	Course 1: Building Engineering	Urban	Insurance agent	Litter-picking and street cleaning (EPWP)

6.2 THEORETICAL DIMENSIONS

I commence this chapter by tracing the development of waste management per case from home to the project using Bernstein's pedagogical device theory and the extensions thereof out of Maton's legitimate code theory (discussed in more detail in Chapter 2). Bernstein (2000, pp. 155- 174) differentiated between scholarly (scientific) knowledge within vertical discourse and every day (common sense) knowledge within horizontal discourse. Vertical discourse knowledge is described as scholarly, educational, professional, coherent and explicit while in the horizontal discourse, knowledge entails sets of strategies which are local, segmentally organised, context-based, specific and dependent on context. In this context and chapter scientific knowledge is not referring to the natural sciences but to scholarly, theoretical knowledge which is knowledge acquired through formal interventions. This knowledge is associated with academic disciplines.

The other type of knowledge referred to in this chapter is termed everyday knowledge. It is described as knowledge which is contextualised and emanating from people's social practices. This does not mean that everyday knowledge is necessarily unscientific. According to Bernstein (2000), everyday knowledge is concerned with the knowledge of the everyday world: "It is tied to specific contexts and events and only done and understandable within those specific contexts. It can only be applied in that context not in other contexts" (Bernstein, 2000, p. 157). Both these types of knowledge are important and useful and the boundary between them is that they differ in the ways in which they are produced and acquired. The concepts above are utilised to describe the knowledge that emerged from the interview data that is shared in this chapter.

As discussed in Chapter 2, Maton (2010) developed a framework called Legitimation Code Theory (LCT), which is used to provide explanations for problems in empirical research. It analyses the bases of achievement underlying social contexts as a means of understanding practice (Maton, 2000; 2007; 2010, see sections 2.3.5.3 and 2.3.5.4). It views practices of agents as embodying languages of legitimation. Maton (2013, p. 29) said when authors and agents make knowledge claims and engage in practices, they are making claims on the legitimacy of those practices for that particular field, that is they are declaring which knowledge

is worthwhile. Through his framework, he developed a differentiating process for discerning knowledge and knower structures (see section 2.3.5.3). According to Maton (2004), knowledge structure is related to Bernstein's hierarchical structuring of knowledge and is represented by specialist, explicit, coherent knowledge associated with scientific (scholarly) procedures and skills (Maton, 2007, p. 92). He conceived the knower structure from humanities culture discussed by Snow in 1959 (Maton, 2007, p. 90). He stated that humanities culture was based in classics, but it was not the skills and techniques of classics that characterise a humanities culture but the character, sensibilities and attributes of learners of classics (Maton, 2007, p. 90). A knower within a field is therefore labelled or marked by its character and attributes.

The specialisation dimension, as also discussed in Chapter 2, argues "knowledge claims and practices of actors or agents identify the basis of achievement with in a field, subject or discipline" (Maton, 2014, pp. 54 -56). The interviewees in this chapter are therefore the actors or agents referred to above. They are making knowledge claims related to the practices of waste management. The claims that they make may be knowledge based or knower based. Knowledge based claims are explained through and based on mastery of specialised waste management knowledge (ER+), procedures, techniques or skills which is a category within the specialisation dimension in Legitimate Code Theory, or knower based which is based on the emphasis on social relations (SR+) which are inclusive of the character, sensibilities and attributes of the agents as discussed by Maton (see section 2.3.5.3). Responses to the interviews will therefore show which forms of waste management knowledge are emphasised by the workers from their home, schooling and project experiences. As can be seen from the biographical details in Table 6.1 and 6.2 above, some of the workers have also had prior work experience which relates to cleaning or waste management. They may therefore also bring knowledge of waste management from these prior work experiences.

When specialist knowledge is emphasised, it indicates that there is an insulated boundary between workers' specialist waste management knowledge and everyday knowledge. As shown in Chapters 4 and 5, waste management knowledge has a stronger epistemic relation ER+ and a weaker social relation SR- meaning that the social relation is downplayed, a phenomenon that I traced through to the Pedagogical Field of Reproduction in previous chapters. The knowledge emphasised by the workers from home, the school and the projects will be explained in terms of everyday knowledge and scholarly knowledge and also in terms of epistemic and social relations. I proceed now with a discussion of the workers interviewed

in Project 1 and I later proceed to workers in Project 2. As noted above, six workers were interviewed in each project.

6.3 BIOGRAPHIES AND WASTE MANAGEMENT KNOWLEDGE OF THE WORKERS IN PROJECT 1 AND PROJECT 2

6.3.1 Biographical Information Overview

An overview of the biographical information of all the participants can be found in table 6.1 and table 6.2 in section 6.1 above. Based on this (in section 6.3.2 and 6.3.3), I share the waste management knowledge of the workers using a narrative style, dealing with each worker's knowledge in turn to ensure that the nuances of their waste management knowledge is captured.

6.3.2 Waste Management Knowledge of the Workers in Project 1

6.3.2.1 Waste management knowledge of Cawekazi

Cawekazi was born and grew up in the rural areas of the Eastern Cape. She also attended schools in the Eastern Cape. She passed grade 12 and never proceeded to tertiary education. She got employment in the EPWP project as a general worker. In her previous job she was doing litter picking and cleaning of streets in Intsika-Yethu municipality. The project in which she was employed was similar to the one she is working in today.

Waste management knowledge from home: In her responses to the interview she indicated various types of home waste and how this is managed. She listed the following as examples of waste from her home: "*paper, food, peels of potatoes and cabbages, glass, tins, small rocks, soil and sand and old clothing"*. She said: "*They manage the waste by picking it up and sorting it and putting it into different plastics [plastic bags]. A vehicle from the municipality comes and collects the plastics."* This household has elements of being situated in a semi-urban area where there are waste collection services provided by the municipality. Cawekazi indicated that they do not put all their waste in the plastic bags to be collected as they deal with some types of waste in different ways: "*We throw the peels of potatoes and cabbages in the garden. They act as manure."* In her biographical data she indicated that she had worked for three months in a cleaning project in a municipality called Ntsika-Yethu, which shows that she has a previous experience of the activities of an EPWP project of this nature. She commented that their supervisor had taught them how to sort the waste.

These comments show application of waste management knowledge. Cawekazi has an understanding that there are elements of waste that go to landfill and other elements of waste

that decompose; at her home they keep the latter separate and throw it in the garden to decompose and increase the fertility of the soil. She mentioned that they used to burn their waste but "*we were taught that waste is not burnt as burning causes problems in the air."*

Waste management knowledge from school: Cawekazi listed the following examples of waste at her previous school: "*plastics, papers for sweets, orange peels".* In response to a question on examples of waste at schools and how this was managed, she commented on the waste management at school as follows: *"When there has been a match, at the school, we would pick up all the dirt. In the school there is a hole which has been dug for dirt. We would take that waste to the hole and burn."*

Waste management knowledge in the project: Examples of waste that were named from Cawekazi's work in the project include papers, plastics, food stuffs, cans and bottles. When responding to questions on the status of waste in project, Cawekazi noted that in town, unlike at home and in her previous school, there was infrastructure for managing waste. "*In each and every area here in town there are bins and a cage. The cage is made up of burglar bars. I think these are there to prevent the waste from being scattered by the dogs."* She also noted that the waste was not sorted and separated according to the waste hierarchy by members of the community: "*Members of the community put the waste in the bins; they do not sort the waste: they put everything in one bag."* The community members were not sorting but Cawekazi and her group were sorting the waste. In the morning they would receive the plastic bags, pick up the waste street by street and take the plastics to the cages. When she got to the bins and cages she would sort the waste. "*When we get to the bins we sort papers only, tins only and bottles only and the food is put in a separate plastic. ... The cages accommodate and take all the different types of waste but they are already in different plastics."*

She went on to explain: *"When we have cleaned and put the dirt in plastics we tie the plastics and put them in the cage. The cage is closed. The waste is collected by the municipal truck. The people moving with the truck collect the plastics from the cage."* In the project, Cawekazi showed that there was a clear routine of activities. Her daily activities illustrates that in the project, scholarly or theoretical knowledge regarding waste was emerging. Cawekazi indicated that she learned the different procedures, processes and techniques during her previous experience participation in the litter (waste) cleaning and streets cleaning EPWP projects. This raises the question as to whether other workers have the same experience or not.

She explained: *"The lady from Masiqhame [the previous project] taught us that we need to pick up almost everything. We were of the idea that some of the things cannot be picked they need to be left there to rust and rot by themselves … Some waste decomposes and others cannot. She taught that most of the waste can be used as (isichumiso somhlaba) to enrich and fertilise the soil"….* She also … "*Taught us that waste is not burnt as that is detrimental to the environment."*

This shows that in the previous EPWP project Cawekazi was exposed to picking up different types of waste and was taught different processes and procedures of waste management. She was exposed to specialised/ scholarly or scientific waste management knowledge.

6.3.2.2 Waste management knowledge of Luma

Luma was born and grew up in the rural areas of the Eastern Cape. He also attended school in the Eastern Cape. He recently (in 2013) passed grade 12 with a B symbol but did not proceed to tertiary education due to financial constraints. He got employment in the EPWP project as a general worker, where he was doing litter picking and cleaning of streets.

Waste management knowledge from home: Luma indicated diverse types of waste and how that waste is managed at home. He listed the following as examples of waste from his home: "*Paper, plastics, bottles, tins, cow dung, tree leaves and barks, dust from outside, soil and sand, and pampers [disposable diapers]".* The details of waste outlined by Luma gives an indication that his home is situated in a rural area: "cow dung" as one of the examples of waste indicates that they are keeping cattle at this home. Secondly, most of the waste listed is organic waste as per the waste definitions given in the Waste Management Act No. 59 of 2008. He uses his school knowledge to differentiate between the different types of waste. He said, "*Some of the waste can decompose while the other types cannot decompose."* He listed examples of the waste types that can decompose: *"tree leaves, peels of vegetables and fruits, cow dung and foodstuffs".* He said that waste that decomposes is of benefit to the people as it fertilises the soil, which he learned from his agriculture teacher who taught him in high school. He said "*The agriculture teacher taught us not to burn the paper as it can be used for composting but we were beaten by vote as most of the learners saw what we were proposing as a lot of work that will take more time".* He further tells how they managed the waste at home. "*We raked the waste that can decompose and threw it in the garden especially in winter. When the rains come they make it flat. It makes the soil fertile as it is ploughed into the soil."* At home Luma knew

about reusing of waste. He understood that some of the waste can be used, especially the waste types that can decompose, to fertilise the soil.

He seemed to struggle with how waste which does not decompose is supposed to be treated. He *"throws the tins, bottles, plastic and paper into a hole and burns them"*. This is unacceptable according to scientific, scholarly waste management standards. As discussed in Chapters 1 and 4, there are procedures set in waste management legal frameworks to deal with these activities.

Waste management knowledge from school: This section aimed at tracing the waste management knowledge that Luma acquired at school. Luma had recently completed school (shortly before the interviews in 2013). He reported that during his final years at school there was a feeding scheme. There were mothers who were preparing food for the learners at school. Examples of school waste included *"paper, bottles, plastics, food, tins, old equipment like planks from old desks, steel frames from old desks, and tree branches from pruned trees"*. The feeding scheme produced waste such as bottles, plastics, food and tins. This also had an impact on how waste was managed: *"For the food waste - the local people were bringing buckets for waste food to be put in. They used that food to feed the pigs at their homes (reuse)."* Thus, instead of the food being thrown outside to contaminate the environment and attract rodents it was reused as food for animals. In the school there were old planks from old desks which were not used. *"Some of the desks remnants were fetched by government trucks to be repaired*", but he pointed out that as local boys had no furniture they often reused the planks. He commented that: "*As learners in this school we were day scholars staying far from home and renting in homes around the school, we did not have tables. We used some of the planks to make small tables (reuse). Desks equipment is fetched by government trucks to be refurbished/ repaired."*

With Luma recyclables like *"paper, bottles, plastics, and tins"* were a challenge. He indicated that *"tins, paper, plastic and bottles were all thrown in the hole and burned"*. This is unacceptable according to scientific, scholarly waste management standards as there are procedures outlined in in waste management legal frameworks to deal with these activities, which were clearly not penetrating the school.

Waste management knowledge in the project: In the project, Luma noted the following types of waste: papers (from sweets and chocolates), plastics, cardboard, pampers [disposable diapers], old food from restaurants and food thrown away by people. Luma listed the above as

examples of waste they identified in the project. He specified clearly the part played by people in the promotion of the status of waste management in the town. He said besides food thrown away by businesses, there is also food thrown away by people themselves. They throw away whatever they do not want. He also described the structure of the town as having different residential areas "the formal and the informal" which also differ in terms of available waste management services:

> *In this town there are different residential areas the informal (imikhukhu) at GPO [name of the informal settlement], and the formal serviced areas. There are no municipal services in the slum area and no toilets. This area is next to a river. All sorts of waste are deposited next to the river – I wonder what happens when it rains that dirt is deposited into the river. No cleaning takes place there.*

In town unlike at home and at school there was infrastructure for managing waste. Luma states: "*In town there are steel bins and steel cages. The plastics bags are put inside the bins. From the cages the waste is collected by the municipal trucks but there are no municipal services in the slum area and no toilets."*

The waste is not sorted and separated according to the waste hierarchy by members of the community. "*Members of the community do not sort the waste, they just throw anywhere, anyhow".* Luma and the other workers in the EPWP project sorted the waste: "*We cleaners come with plastic bags every morning, we put the waste into plastics: tins alone, paper alone – we sort … We put the waste in different plastics, tie them and put the plastics in the cages. From the cages the waste is collected by the municipal trucks. I do not know as yet where they take the waste to."* The daily routine illustrates that knowledge of the scholarly processes and procedures of waste management namely picking, sorting and separation, storage, collection was emerging in the project as well as disposal.

Luma also raised challenges caused by the people's attitudes and behaviours and how they influenced the status of waste within the town. As indicated above, there are bins and cages in town and formal residential areas but he pointed out that:

> *People do not use bins, when full or satisfied with what they were eating, they just throw what we're eating away on the ground. The members of the community and the businesses are supposed to put their waste in the bins but they do not care. Most of the time we get the plastics sunk in the bins, as the people just throw anyhow. They are saying they are creating more work for us cleaners so that we do not lose jobs because of the reason that there is no waste … In the formal residential areas – there are bins but people do not care. You would find that the bins are not full but the streets are dirty showing that they do not use the bins properly … Even in the rural areas there are*

dumping sites, when people are renovating their homes and changing carpets they throw that on the open spaces which end up as dumping sites and everyone is dumping there.

Luma outlines that the attitudes and behaviours of people in town contribute to the status of waste management in the town. They are behaving contrary to the expectations of dealing with waste in the environment. They see waste as the task of those employed and not their function. The result becomes the creation of dumping areas.

Luma's responses show an understanding of scholarly knowledge in waste management. He said that he got some of the knowledge from his agriculture teacher and he indicated that they were also taught in the project. Elements taught in the project included: "*We were taught safety measures before we got into the field. We were taught that waste is not burnt. We were taught that waste can be beneficial to us and that we need to sort the waste*."

He struggled with how recyclables are managed. They still put them together for disposal in the landfill which the waste hierarchy is trying to discourage.

Waste management knowledge in the project: Both epistemic as well as social relations emerged from the data derived from project activities. In the data there is an emergence of waste management specialist knowledge associated with the names of waste types and the waste hierarchy, as well as procedures of waste management and waste management prevention (scientific/scholarly knowledge).

6.3.2.3 Waste management knowledge of Love

Love was born and grew up in the rural areas of the Eastern Cape. He also attended schools in the Eastern Cape. He passed grade 12, but did not proceed to tertiary education. He got employment in the EPWP project as a general worker.

Waste management knowledge from home: In his responses, Love indicated types of waste and how that waste is managed at home. He listed the following as the examples of waste from his home: *"Plastics, bottles, dust / soil and sand, tins, grass cuttings and potato peels"*. They manage the waste at home by separating the grass from the waste and making compost with it in the garden. "*We separate the grass and make compost."* He treated the potato peels differently from the grass: "*I put the potato peels in the hole and burn them"*. Love explained

further: *"The tins are collected by a group of mothers who collect the tins. He says they collect them, compact them and take them to Durban."*

Love's home knowledge emphasises everyday knowledge more than scientific knowledge. While grass and peels of vegetables have the same characteristics (i.e. biodegradable), they are not used similarly for composting as they still burn some of the biodegradable waste. He also did not offer an explanation for recycling waste tins, other than that they were taken to Durban.

Waste management knowledge from school: Love listed the following as the examples of waste from his school: *"Paper, plastic, glass from broken windows, planks from old desks, steel from broken desks"*. He explained that they managed the waste at school by composting and recovery. He said "*Paper is put into a hole and put the soil on top of it; it is a way of composting.*" This is a way of composting and when the waste has decomposed it will make the soil fertile.

He explained further: *"Plastics were burnt to prevent the plastics from being eaten by the cattle. They die when they have eaten plastic. Planks and steel are collected by a truck to be refurbished"*. In these responses, Love places emphasis on everyday knowledge (contextual) more than scientific knowledge (scholarly). For example, the reasons he puts forward for burning waste are relevant to the agricultural activities practised in their context.

Waste management knowledge in the project: Love listed the following as examples of waste in the project, namely "*Papers, plastics, cardboard, pampers, glass, dust and soil which are a result of sweeping.*" What emerged in the responses from the status of waste in project was the fact that in town, unlike at home and in the school, there was infrastructure for managing waste. He explained that in the project they pick up the waste, put the waste in different plastics, tie them and put the plastics in the cages. From the cages, the waste is collected by the municipal trucks. "*I do not know as yet where they take the waste to. What we did not put in plastics is the soil. We use it to close the ditches in town. From town the trucks take the waste to the tip [landfill]".* His earlier explanation seems to imply that he did not know where or what the 'tip' was.

Love claimed that he sorted the waste: "*When they sort they put bottles and tins together; put paper and plastics together".* However, this explanation does not accord with acceptable or prescribed waste management procedures and processes. One cannot combine tins made up of aluminium and bottles made of plastic or glass and also one cannot combine paper and plastic

unless one is preparing for burning. In the project it would seem that Love was developing some scientific waste management knowledge, but Love was, as yet, not well informed about the processes. With him everyday knowledge about waste management was more prominently in focus than scientific or scholarly knowledge of waste management.

6.3.2.4 Waste management knowledge of Happy

Happy was born and grew up in the rural areas of the Eastern Cape. He also attended schools in the Eastern Cape. He passed Grade 12 but did not proceed to tertiary education. He was employed by the EPWP project as a general worker.

Waste management knowledge from home: In his responses to the interview, Happy indicated types of home waste and how that waste is managed at home. He listed the following as the examples of waste from his home: "*Paper and plastics; garden waste, tins and bottles, foodstuffs, dust from outside, soil and sand, sheep manure and poultry manure".* This kind of waste is indicative of a home situated in a rural area where sheep and chickens are kept. According to the municipal bylaws, the keeping of animals such as these is prohibited in an urban environment.

With regard to the way they manage waste at home, Happy indicated that for the soil, paper and garden waste, they dig holes in the garden and bury these forms of waste:

> *We do that with the hope that they will decompose and increase the fertility of the soil (reuse) … Sheep manure and poultry manure, we throw them in the garden and they act as manure (reuse) … Food stuffs are given as food to pigs and dogs but at home we do not have pigs but our neighbours have. Therefore peels and food are stored in buckets and given to neighbours as food for pigs (reuse).*

Happy's knowledge of waste management at home was mostly guided by his context or everyday knowledge. Most of the procedures they use for managing waste are informed by their rural activities, which are related mainly to agriculture. As can be seen from the citation above, he had a good understanding of how biodegradable waste can be reused: in the garden to fertilise the soil or as animal feed.

The challenge for Love lay in how to deal with non-biodegradable waste, that is the waste, which does not decompose. *"We throw the plastics, tins and bottles in a hole in the garden*" This practice is not acceptable according to waste management scientific knowledge as plastics,

tins, and bottles cannot decompose. Consequently, his home-based waste management places emphasis on everyday knowledge more than scientific knowledge of waste management.

Waste management knowledge in the school: Happy listed the following as the examples of waste from his last school: "*Paper and plastics which are brought by the kids who sell sweets and also coming from books. Soil and sand which results from sweeping of classrooms*". He indicated that food waste is something new in the schools as during his time there was no food in the schools.

"*Learners in the school were instructed to pick up litter within the school yard. They would pick up the papers and plastics and put them in one heap. A truck would come from the municipality to collect them. The soil and the sand were thrown in the hole in the garden*." Happy's school waste management knowledge places more emphasis on everyday knowledge than scientific knowledge.

Waste management knowledge in the project: Happy listed the following as examples of waste in the project: *"Papers, plastics, cardboard, pampers, bottles both plastic and glass. Old food from restaurants, branches of pruned trees, tins of soft drinks and liquor, and tins of beans and fish".* Happy's responses also indicated that in town, unlike at home and at school there was infrastructure for managing waste. Municipalities have steel bins and steel cages. The plastics bags are put inside the bins. The members of the community and the businesses are supposed to put their waste in the bins. In the project as cleaners they pick up the waste, put the waste in different plastic bags, tie them and put these in the cages. From the cages the municipal trucks collect the waste. He also did not know yet where waste was taken.

Happy claimed that they sorted the waste by putting bottles and tins together and putting paper and plastics together. What they did not put in plastics was soil. The plastic bags are put next to the bins and are collected by trucks. Households put bags outside on the street and the municipal truck collects the waste. Happy indicated that there was infrastructure in the form of bins in town and in formal settlements there are bins while there are none in the informal settlements.

Emergent from his responses are people's attitudes and behaviours towards the management of waste. He said,

> *The members of the community and the businesses are supposed to put their waste in the bins but they do not care. Most of the time we get the plastics sunk in the bins, bins*

not full as the people have just thrown anyhow. Others throw next to the bins while others do not use the bins at all. Though formal settlements have bins they do not care about how waste is handled. They throw waste on the ground, bins are not full but the streets are full of filth. In the slum areas, the citizens have created dumping areas, which are not authorised by the municipality.

In Happy's discourse there is an emergence of waste management specialist knowledge, and knowledge of the waste hierarchy, procedures of waste management and waste management prevention (scientific/scholarly knowledge). Knowledge of procedures and processes from collection to disposal are gradually surfacing in his discourse about waste management, based on his experience in the project so far.

6.3.2.5 Waste management knowledge of Andisiwe

Andisiwe was born and grew up in the rural areas of the Eastern Cape. She also attended schools in the Eastern Cape. She passed grade 8 and got employment in the EPWP project as a general worker. Before joining the project, she worked as a cleaner in a similar EPWP project.

Waste management knowledge from home: Happy listed the following as the examples of waste from her home: *"Paper and plastics; dust from outside, soil and sand, old clothes, peels of potatoes, cabbage and food; grass and garden weeds, kraal and sheep manure"*. This indicates that her home is situated in a rural area as cattle are kept at this home. At home they manage the waste by throwing the *"food stuffs and peels of vegetables, kraal manure, sheep manure and fruit peels in the garden so that they fertilise the soil. The garden weeds and grass they also bury them in the garden. They also bury the paper, plastic and old clothes and cloths in the garden. After sweeping we throw the soil in the garden."*

At home Andisiwe seems to be burying waste that is not used for composting in the garden. Her everyday knowledge is emphasised more than scientific knowledge.

Waste management knowledge from school: Andisiwe identified paper from books as the most critical example of waste in their school environment. They managed this waste by digging a hole in the garden, putting the paper in the hole and covering it with soil.

Waste management knowledge in the project: Andisiwe listed "*papers, plastics and cardboard*" as examples of waste in the project. She explained that they collect paper and plastic, put them in plastic bags and then in a cage and municipal trucks collect the bags from here. Some of the cardboard was too big to fit into plastic bags. In addition, some people around town collect the cardboard: "*When we put the cardboard in the plastics the women who collect*

cardboards tear the plastics looking for the cardboard. We decided to pack them aside for the group to collect".

6.3.2.6 Waste management knowledge of Sindi

Sindi was born and grew up in the rural areas of the Eastern Cape. She also attended schools in the Eastern Cape. She passed grade 11 but never completed grade 12. She was employed by the EPWP project as a general worker. Before joining the project she was a cleaner in a furniture shop.

***Waste management knowledge from home*:** Sindi listed the following as the examples of waste from her home: *"Paper and plastics, food, bottles both glass and plastic, grass, goats manure, poultry manure, garden waste and old sheets of zinc".* This is an indication that her home is situated in a rural area. At home they manage waste by: "*throwing goat manure, poultry manure, food stuff, vegetable and fruit peels and green garden waste in the garden. In the garden they act as manure and fertilise the soil. After sweeping they throw the soil in the garden".*

She stated: *"With regards to the sheets of old zinc (metal) we were packing them neatly next to the garden fence and put stones on top so that they are not blown away by wind. Now they are sold to trucks that pass by who are buying metal works".* This shows a commitment to reuse and to gaining income from waste.

Waste management knowledge from school: Sindi listed the following as the examples of waste from her last school as "*plastics, papers from books, grass, and soil and sand which resulted from sweeping of classrooms*". Sindi described the way the waste was managed in the school as follows: "*The waste was collected and burnt in a hole at the corner of the yard. Grass was burnt at school. Soil is also thrown in the hole".*

Waste management knowledge in the project: Sindi listed the following *"Papers, plastics, cardboard, pampers, bottles both plastic and glass. Old food from restaurants, branches of pruned trees, tins, food, dust/ soil or sand resulting from the sweeping, cabbage, banana and orange peels*" as examples of waste in the project. With regard to the way that they are managing waste in the project, she stated: "*We are given plastics on a daily basis. We collect the waste, put it in plastic bags and put it in a cage. From the cages municipal trucks collect the waste from the cages and take the waste to the tip".* She continued, *"In the project we have*

been taught not to burn the paper but to bury it in the garden as it will decompose and act as manure."

6.3.4 Summative perspective on Waste Management Knowledge of workers in Project 1

Table 6.3 below provides a summative perspective on the waste management knowledge that workers bring to the project from home and school. It also provides a summative perspective on their waste management knowledge near the start of the project. In the table I explain the types of knowledge emphasised in each category. The table below shows that some forms of everyday knowledge have scientific relevance (e.g. composting of organic waste for improving soil fertility or re-using materials for other purposes). The table also shows that some other forms of everyday knowledge contradict or are unacceptable in terms of the waste management regulations, norms and standards. The data shows that in some areas participants are unaware of theoretical, scientific knowledge of waste management. In the absence of critical infrastructure they are unable to practise the theoretically acceptable ways of managing waste which leads to inappropriate waste management practices (such as burning or burying waste which could be diverted into recycling processes as advised in waste management legislation and policy). The discourse of participants above also shows that such knowledge or infrastructure is not readily available in rural areas, hence the heavy reliance on everyday forms of waste management knowledge, both in home and school settings. The data further shows that the project is introducing scientifically constituted forms of waste management knowledge, and that participants are implementing this in their practice.

Table 6.3: Summative perspective on waste management knowledge of workers in Project 1

Name of workers	Waste management knowledge from home	Waste management knowledge from school	Waste management knowledge in the project
Cawekazi	Her waste management knowledge from home show elements of scholarly knowledge. They use biodegradable waste as manure Brought scholarly knowledge from being trained in the previous projects. From their home area there is collection of	In the school emphasis is on everyday knowledge. They use contextual ways of managing waste. Everyday knowledge is emphasised at the expense of scientific knowledge. There are no facilities to enhance the use of the scholarly approach.	Cawekazi indicated that in town where the project was implemented there was infrastructure in the form of bins, cage made up of burglar and a lorry. In the project, they would be supplied with plastic bags to clean the bins and separate the waste.

	waste by facilities and transport from the nearby town for disposal in the tip but there is no indication of issues of sorting and separation from source.		Seems not to be informed by the prescribed ways of sorting the recyclables The cages were used to save the plastic bags from being destroyed by stray dogs. The truck would come and transport the waste to the tip. The collection to the tip was not done on a daily basis, which was a challenge. That is where the cages were helpful as they were locked. There is emergence of scholarly practices in the project but they are incomplete. The participants need more exposure to waste management scholarly knowledge contained in legal frameworks.
Luma	Emphasis on everyday / contextually derived waste management knowledge He understands that only some of the waste can decompose. He used his school knowledge to understand the activities related to waste at home Practised composting and reuse but their activities were related to their contextual activities and areas. Did not understand the scholarly way and scientific way of dealing with tins, plastic and paper. They put these all together and put them into a hole to burn.	Emphasis on everyday / contextually derived waste management knowledge Activities at the school were influenced by the activities in their context. He emphasised elements contained in the waste hierarchy. They reused the leftovers of the feeding scheme as food for domestic animals. They used the old desks to make study tables. They did not deal with scholarly knowledge in waste management as they were not aware of the legal structures to support waste management services	Depicted the different forms of residential areas in town and how waste management is addressed in each. Formal residential areas had services while the informal had none. Formal residential areas and the CBD had infrastructure in the form of bins, steel cages plastics and a truck while the informal had none. Scholarly processes of waste management guided by the waste management legal frameworks are emerging in the project as there is reference to waste being separated, stored, collected and disposed in the tip.
Love	Emphasis on everyday / contextually derived waste management knowledge. Good knowledge of treating and managing	Emphasis on everyday / contextually derived waste management knowledge Good knowledge of treating and managing biodegradable waste, and re-use	In the project there is infrastructure in the form of bins, cages and a truck. Waste management scholarly knowledge is emerging as there are elements of separation and collection in the project.

	biodegradable waste, and re-use. Inadequate practices for treatment of other waste streams due to lack of support structures, infrastructure for waste management in rural areas, and knowledge of waste management hierarchy and legislation.	Inadequate practices for treatment of other waste streams due to lack of support structures, infrastructure for waste management in rural areas, and knowledge of waste management hierarchy and legislation.	The waste hierarchy is still incomplete, because though the waste is separated it is still taken to the same destination the tip. No landfill site.
Happy	Emphasis on everyday / contextually derived waste management knowledge Good knowledge of treating and managing biodegradable waste, and reuse Inadequate practices for treatment of other waste streams due to lack of support structures, infrastructure for waste management in rural areas, and knowledge of waste management hierarchy and legislation	Emphasis on everyday / contextually derived waste management knowledge. Good knowledge of treating and managing biodegradable waste, and reuse Inadequate practices for treatment of other waste streams due to lack of support structures, infrastructure for waste management in rural areas, and knowledge of waste management hierarchy and legislation	Emergence of waste management specialist knowledge, and knowledge of the waste hierarchy, procedures of waste management and waste management prevention (scientific/scholarly knowledge) Knowledge of procedures and processes from collection to disposal are gradually surfacing due to experience in project.
Andisiwe	Emphasis is on everyday knowledge. Waste management is influenced by the contextual practices. Composting through throwing biodegradable waste in the garden is key. He is not informed about what to do with non-biodegradable waste. They also bury it in the garden.	Emphasis is on contextual and everyday practices. Waste is put into a hole and covered with soil to promote decomposition.	In town there is infrastructure in the form of bags, bins, steel cages and a lorry for waste collection. Also challenged by waste collectors (scavengers) who open the plastic bags to collect recyclables in the form of cardboard and tins Elements of the waste hierarchy are emerging.
Sindi	Emphasis is on contextual activities. Waste is inclusive of materials which are a products of their contextual activities e.g. poultry and goat farming.	In Sindi's school all the waste is collected and put into a hole where it is burnt. Using everyday knowledge which is influenced by contextual activities as there are no facilities to support the scholarly knowledge and	In the project there is infrastructure in the form of bins, plastic bags, steel cages and a truck. Knowledge of the waste hierarchy is emerging. They collect the waste, put it in plastics which are put into cages

	Throw the waste in the gardens to promote fertilisation of the soil They are committed to reuse especially around metal works. They sell metal to collectors.	the practices prescribed in the waste management legal frameworks	to prevent them being torn by dogs. From the cages the municipal trucks collect it to take it to the tip. No licenced landfill site.

6.3.5 Waste Management Knowledge of Workers in Project 2

6.3.5.1 Waste management knowledge of Abongi

Abongi was born and grew up in the rural areas of the Eastern Cape. He also attended schools in the Eastern Cape. He dropped out of grade 9 due to health reasons. He never completed grade 12. He was employed by the EPWP project as a general worker. Before joining the project he was a cleaner in Durban and also roasted meat. He is working as a supervisor in one of the cleaning and beautification projects in the Eastern Cape.

Waste management knowledge from home: Abongi listed the following as the examples of waste from his home: *"paper, food and peels of potatoes and cabbage, glass, tins, small rocks, soil and sand, old books, the plastics, old clothing, weeds and grass after hoeing."*

He explained how they manage the waste at home:

> A*t home we throw poultry manure in the garden. It acts as fertiliser in the garden. We bury mealie stalks, the peels of potatoes and oranges in the garden. They act as manure in the garden and fertilise the soil … When I have used something and do not need it anymore, I do not throw it away. I check with other people around me if they need it and give it to people who need it … I give old books I do not use to other kids who need them. We keep the plastics and use them later.*

Abongi also indicated that he burns old clothes that he does not need. He puts weeds and grass while working in the garden next to the fence to dry before burning them. His activities at home emphasise everyday knowledge more than scientific knowledge.

Waste management knowledge from the school: Abongi listed the following as examples of waste from his last school: "*plastics, papers for sweets and orange pills"*. At school, they managed the waste by "*picking up all the dirt … In the school there is a hole which has been dug for dirt. We would take that waste to the hole and burn it".*

All the school waste that was collected inclusive of biodegradable and non-biodegradable was put into a hole and burned. The activities at school emphasise everyday knowledge more than scientific knowledge.

***Waste management knowledge from the project**:* Abongi listed the following "*papers, plastics, cardboard, pampers [disposal diapers]"* as examples of waste in the project. He explained how they managed the waste in the project. They would sweep and pick up the papers and plastics. These were placed in plastic bags and are taken by a truck to where they are burnt. The waste is collected by the municipal truck every day between 7h30 and 18h30. Collection is done in the central business area and residential areas. He indicated that they "*do not sort the waste – they put the waste into plastic bags, tie them and put them next to the road*." The truck from the municipality collects the bags and takes them to the tip. They throw the plastics away as they are. His activities at the project are informed by everyday knowledge more than scientific knowledge.

6.3.5.2 Waste management knowledge of Khaya

Khaya was born and grew up in the rural areas of the Eastern Cape. He also attended schools in the Eastern Cape. He completed grade 12 and proceeded to tertiary education. He attended tertiary education in an urban setting. He did experiential training in a school setting. After completing school he did not get formal employment. He is working as a supervisor in an EPWP cleaning and beautification project in the Eastern Cape.

Waste management knowledge from home: Khaya listed the following as examples of waste from his home: *"paper, bottles, dust from outside, soil and sand, poultry and stock manure, old clothes"*. Inclusive in his list according to the waste management legal frameworks and experts are biodegradable and non-biodegradable waste. He explained how they manage waste:

> *After sweeping we throw the soil in the garden … We have poultry manure which we throw in the garden. It acts as the fertiliser. We also bury mealie stalks in the garden, they rot and fertilise the soil; we mix the sheep manure with manure and throw it in the garden … We throw the papers and clothes away and burn them. For plastic bottles, we have a hole next to the corner of the garden – we throw the plastics and plastic bottles in the hole and burn them.*

They throw the agricultural waste in the garden and they were aware that in the garden it decomposes and creates manure. The challenge is how to manage the recyclables. They were not aware of the properties of the different types of recyclables. Everything was put into a hole

and burnt. They were not informed about the effects of burning of waste. Khaya's activities at home emphasise everyday knowledge more than scientific knowledge.

Waste management knowledge in the school: Khaya listed the following as examples of waste from his last school: "*paper, bottles, old equipment like planks from old desks, steel frames from old desks, computers, tree branches from pruned trees and tins"*. He explained that waste was managed by *"picking up all the dirt and throwing the paper and plastics in a hole and burn them*". He explained further that,

> *Desk equipment is fetched by government trucks to be refurbished/ repaired. Computers are sold to second hand users. Tins are collected by the cleaners. Soil is also buried in the hole. For the food waste, local people bring buckets for waste food to be put in. They use that food to feed the pigs at their homes.*

At school all the waste, both biodegradable and non-biodegradable, was put into a hole and burnt. Waste food is collected by local people to feed their stock. Waste management activities at school emphasise everyday knowledge more than scientific knowledge.

***Waste management knowledge in the project*:** Khaya mentioned the following examples of waste in the project: *"papers, plastics, cardboard, pampers (disposable diapers)."* He noted further that in town, unlike at home and at school, there was infrastructure for managing waste. There are cement bins but some of these were broken.

He described how they manage waste in the project as follows:

> *They put their waste in the bins. Waste is not sorted – they put everything together in one bag e.g. plastics and bottles and tie it. They put it outside on the street and the municipal truck collects the waste … Foodstuffs from restaurants is collected by local people for their pigs. They bring buckets to the restaurants in the mornings and collect them in the afternoons. Other waste is thrown next to the bins.*

They do not practise recycling but they know that it is happening in big towns like Durban. "*We cannot have transport to take our things to Durban. We would like to have a place where we can sell our things."* They do not sort the waste but put everything into plastic bags and place these next to the road. The municipal trucks collect the bags and take them to the tip.

6.3.5.3 Waste management knowledge of Lizo

Lizo was born and grew up in the rural areas of the Eastern Cape. He also attended schools in the Eastern Cape. He dropped out of school in grade 8 and went to work. Previously he worked as a security guard, was then unemployed and then got employment in the EPWP project. He

is working as a general worker in one of the cleaning and beautification projects in the Eastern Cape.

Waste management knowledge in the home: Lizo listed the following as examples of waste from his home: *"thorny shrubs chopped down, grass cut, ash from the fire used for cooking food, paper, bottles, chips of chopped wood, dust from outside, soil and sand and poultry manure".* This kind of waste is indicative of the community: thorn bushes which need to be cut, wood for cooking on fires (not electricity), chickens whose manure is used as fertiliser. The thorny shrubs are left to dry and are then "*thrown on the other side of the fence on unoccupied spaces and next to the mountains"* which indicates that they consider the environment and the place to be cleaned as the space that belongs to them and nothing beyond their yards. He explained further, *"We burn the papers, old clothes, plastics and plastic bottles."*

Local practices shape how they manage waste, such as using manure and ash in the garden as fertiliser. They are also influenced by what Marshall and Farahbaksh (2013, p. 991) call the "not in my backyard syndrome". They consider only their backyards as environments to be cleaned. Waste is taken elsewhere, for example, to open spaces. They also engage in poor waste management practices such as burning. Waste management activities at home emphasise everyday knowledge more than scientific knowledge.

Waste management knowledge in the school: Lizo listed the following as the examples of waste from his last school: "*paper, bottles, weeds from flowers, grass tree branches from pruned trees, and tins."* He explained how they manage waste: *"They burn paper and plastic. Weeds and grass were dried and burned."*

The main approach to managing waste was by burning, indicating that poor waste management practices of the past, such as burning of waste, are still emphasised in the schools. Waste management activities at school emphasise everyday knowledge more than scientific knowledge.

Waste management knowledge in the project: Lizo listed the following: *"papers, plastics, cardboard, pampers, glass, dust and soil which are a result of sweeping".* He explained that they are given plastic bags on a daily basis and put them inside the bins. They pick up the waste and put the waste in plastic bags.

> *When they are full we remove them, tie them and put others. We were taught by people working in the truck that they should not leave the bags until they are too full/ when they are full they tear or get torn. We get the plastic bags from the project … We sort the waste. We put bottles and tins together; put paper and plastics together.*

As shown here, Lizo claims that they sort the waste but the evidence above shows that combinations are not according to correct waste management principles. These practices signify a lack of access to knowledge in waste management legal frameworks which emphasise the waste hierarchy.

He explained that households put their waste outside on the street and the municipal truck collects the waste. He said, "*We collect every day in town. When the trucks have not collected the plastics – in the morning we get all the plastics torn by dogs with waste scattered throughout town"*. Waste management activities in the project emphasise everyday knowledge more than scientific knowledge.

6.3.5.4 Waste management knowledge of Mfana

Mfana was born and grew up in the rural areas of the Eastern Cape. He also attended schools in the Eastern Cape. He dropped out of school at grade 11 and went to work. Previously he worked as a motor mechanic and builder in Mpumalanga. He was out of employment for some time and later got employment in the EPWP project. He is working as a general worker in a cleaning and beautification project in a district municipality in the Eastern Cape.

Waste management knowledge in the home: Mfana listed the following as examples of waste from his home: "*paper and plastics, soft drinks and liquor bottles, dust from outside, soil and sand, tins from canned fruit, old clothes and cloths used for scrubbing, peels of potatoes, peels of fruits and vegetables and old food"*. In terms of managing waste, Mfana said,

> *After sweeping we throw the soil in the garden … We burn paper, plastic and old clothes … We throw the tins into a hole – while old and rusty we collect them and throw them outside the yard by the river side. … At home we do not have pigs but our neighbours have. Therefore peels and food are stored in buckets and given to neighbours as food for pigs.*

Like Lizo, Mfana's practice also shows evidence of the "not in my backyard syndrome" as they throw waste elsewhere, outside the yard and next to the rivers. They also practise burning and there is evidence of re-use practice when they share food waste with the neighbours for the pigs. Waste management activities at home emphasise everyday knowledge more than scientific knowledge.

Waste management knowledge in the school: Mfana listed paper and plastics as examples of waste from his last school. He explained that paper and plastics were thrown in a hole and burnt, showing that burning as a waste management practice was still emphasised at the school.

***Waste management knowledge in the project*:** Mfana listed the following as examples of waste from the project: *"papers, plastics, cardboard, pampers, bottles both plastic and glass, old food from restaurants, branches of pruned trees, and tins of food whose dates for consumption has expired".* He explains that they manage waste in the project as follows:

> *Municipalities have cement bins. The workers are given plastics on a daily basis and put them inside the bins …We pick the waste and put the waste in plastics. When they are full we remove them, tie them and put others….We sort – put bottles and tins together; put paper and plastics together. We do not put soil into plastics … The black plastics bags are put next to the bins and are collected by trucks. The trucks collect every day in town.*

While they sort waste, the sorting is not according to the principles set up in the waste management prescripts, for example, they combine bottles with tins and paper with plastic. The municipal trucks collect the bags and take them to the tip. Their practices signify that they had no access to waste management legal frameworks knowledge which emphasise the waste hierarchy. Waste management activities in the project emphasise everyday knowledge more than scientific knowledge.

6.3.5.5 Waste management knowledge of Sanda

Sanda was born and grew up in the rural areas of the Eastern Cape. She also attended schools in the Eastern Cape. She dropped out of school at grade 11. She was studying in Cape Town when something happened at home and she was forced to leave school. She got employment in the EPWP project. She is working as a general worker in a cleaning and beautification project in district municipality in the Eastern Cape.

Waste management knowledge in the home: Sanda listed the following as the examples of waste from home: *"paper and plastics, dust from outside, soil and sand, old clothes, peels of potatoes, bananas, and cabbage, food, bottles (both glass and plastic), grass, kraal manure, poultry manure, mealie stalks, garden waste".* She explained that they manage waste at home as follows:

> *After sweeping we throw the soil in the garden … We burn paper, plastic and old clothes and kraal and poultry manure are put in the garden and it fertilises the soil. Food stuff*

and vegetable and fruit peels are stored in buckets and given to pigs as food … People collecting tins come to my home and collect them.

They are aware that manure and organic materials decompose and can be used for fertiliser. Managing recyclables is challenging. They are not aware of the properties of the different types of recyclables. They put all of them in a hole and burn them. They are not informed about the effects of the burning of waste. Her activities at home emphasise everyday knowledge more than scientific knowledge

Waste management knowledge in the school: Sanda listed the following as the examples of waste from school: *"paper from books, old equipment like planks from old desks, steel frames from old desks, tree branches from pruned trees."* The waste at school is managed as follows: *"Paper and plastics were thrown in the hole and burnt. Desk equipment is fetched by government trucks to be repaired*." Poor practices of the past, such as burning of waste, continued at the school. The activities at school emphasise everyday knowledge more than scientific knowledge.

Waste management knowledge in the project: Examples of waste from the project were listed by Sanda as "*cardboard, pampers, bottles both plastic and glass, old food from restaurants, branches of pruned trees, tins, food, dust/soil or sand resulting from the sweeping"*. For managing the waste, the municipality has cement bins. Workers are given plastic bags on a daily basis and put them inside the bins.

We pick the waste up and put the waste in plastics. When they are full we remove them, tie them and put others out. Plastics are put next to the bins and are collected by trucks…. The waste is sorted. We put bottles and tins together; and put paper and plastics together. We do not put soil into plastics. The residential areas have bins. On the days for collection they put the black bags on the routes of the trucks to be collected by the trucks. Some people burn their waste in the evenings when other people are asleep. The trucks do not get to the household so they have to bring their waste onto the routes of the trucks for collection.

As in the other stories above, sorting of waste is not according to the principles set up in the waste management prescripts. Poor waste management practises of the past, such as burning, are still emphasised. Her activities in the project emphasise everyday knowledge more than scientific knowledge.

6.3.5.6 Waste management knowledge of Bongi

Bongi was born and grew up in the rural areas of the Eastern Cape. He also attended schools in the Eastern Cape. He completed grade 12 and proceeded to tertiary education. He attended tertiary education in an urban setting. He dropped out of a tertiary institution because of a shortage of funds. He was not able to find formal employment. He got employment in the EPWP project and is working as a supervisor in a cleaning and beautification project in a district municipality in the Eastern Cape.

Waste management knowledge in the home: Bongi listed the following as the examples of what they consider as waste at home: *"paper and plastics, dust from outside, soil and sand, tins from canned fruit, old clothes, peels of potatoes, bananas, and cabbage, food, grass.* He explained how they managed waste as follows: "*After sweeping we throw the soil in the garden. We burn paper, plastic and old clothes. Peels and food are given to pigs as food."*

They throw agricultural waste in the garden and they are aware that it in the garden it decomposes and creates manure. As with others, the challenge is how to manage recyclables – all refuse is placed in a hole and burnt. They are not informed about the effects of the burning of waste. Bongi's activities at home emphasise everyday knowledge more than scientific knowledge.

Waste management knowledge in the school: Bongi listed the following as the examples of waste from school: *"paper from books, old equipment like planks from old desks, steel frames from old desks, tree branches from pruned trees and tins".* He explained how they managed waste at school as follows:

> *Cleaners were collecting paper and plastics and putting them into bins. The cleaners were separating the waste and putting it into plastics. The trucks would come and collect them in the evenings ... Tins were collected by the mothers collecting tins ... Cardboards were packed and made into stacks in trolleys. Men and women pushing trolleys would collect those (i.e. informal collectors). Grass was burnt at school. To manage food waste, local people were bringing buckets for waste food that was used to feed the pigs at their homes.*

This evidence indicates that these activities did not take place in a rural area but in an urban setting and in a well organised institution. There is evidence of separation of waste into categories which are serviced by different stakeholders. Tins are collected by women, cardboard is stacked and collected by informal recyclers and local food waste is collected for

re-use in pig farming. Bongi's story shows that from as early as at the level of the school environment, more specialised knowledge of the waste hierarchy is emerging. Compared to other stories above, it is clear that this shifts the boundaries between everyday knowledge and scientific knowledge.

Waste management knowledge in the project: Bongi listed the following as the examples of waste from project: "*papers, plastics, cardboard, pampers, bottles both plastic and glass, old food from restaurants, branches of pruned trees, tins, food, dust/ soil or sand resulting from the sweeping"*. He explained how waste was managed as follows:

> *The Municipality has cement bins, we are given plastics on a daily basis and put them inside the bins. We pick up the waste and put the waste in plastics. When they are full we remove them, tie them and put others out. The waste is sorted. We put bottles and tins together and put paper and plastics together. Cardboard is put into plastics. The plastics are put next to the bins and are collected by trucks. Residential areas have bins and they put plastics into them. When ready they tie them and put them on the routes of the trucks to be collected by the trucks. The trucks do not go directly to the households so people have to bring their waste onto the routes of the trucks for collection. In general people do not sort their waste, they mix everything in one plastic bag. The trucks deliver the loads to the landfill (tip). It is burned – after burning it is compacted with TLB (Uganda-ganda) … Waste is collected every day in town.*

6.3.6 Summative perspective on Waste Management Knowledge of workers in Project 2

Table 6.4 below, like Table 6.3, provides a summative perspective on the waste management knowledge that workers in Project 2 bring to the project from home and school. It also provides a summative perspective on their waste management knowledge near the start of the project. As can be seen from Table 6.3 and Table 6.4, the dominance of everyday knowledge in Project 2 is more visible than than in Project 1. All the stories show that at home the participants are generally not practising with much of the theoretical, scientific knowledge of waste management found in research and policy. They utilise and emphasise contextual ways of managing waste which are not detrimental to the environment as most of their waste is biodegradable and is a product of their practices of stock farming and crop farming. They practice reuse as they throw those products in their fields to fertilise the soil in preparation for the next season. In this area there is no infrastructure as prescribed in the legislation, and in the absence of infrastructure and support systems for such waste management knowledge, some end up participating in inappropriate waste management practices (such as burning or burying waste). It is therefore critical for the participants to be trained in order to get access to theoretical knowledge in the field.

Even in the EPWP project, the data shows that the participants are not guided towards more theoretical and scientific ways of waste management. Every morning they simply collect waste and put it into plastic bags in the cement bins, clean around them and when they are full tie and set the bags aside for collection by the truck for removal to the tip where the waste is burned, which in itself an inappropriate waste management strategy for municipalities according to policy. When considering the waste hierarchy and scientific ways of dealing with waste, the data shows that everyday knowledge is emphasised more than formal scientific waste management knowledge at home, in schools, and at the start of the project's activities. It is imperative therefore for training to be emphasised in the projects.

Table 6.4: Summative perspective on waste management knowledge of workers in Project 2

Names of workers	Waste management knowledge from home	Waste management knowledge from school	Waste management knowledge in the project
Abongi	His waste management knowledge from home emphasises everyday knowledge more than formal, scholarly, scientific knowledge. Everyday knowledge is influenced by contextual activities. Some of their practices though contextual have scientific relevance e.g. throwing poultry manure in the garden to improve the fertility of the soil.	In the school, emphasis is on everyday knowledge more than scientific knowledge. There is an absence of infrastructure in the area which leads them to practice unacceptable ways of managing waste like waste burning and burying non-biodegradable waste in the soil e.g. plastic.	Everyday knowledge is emphasised at the expense of scientific waste management knowledge in the project. Cleaning is emphasised more than waste management activities. Workers sweep and pick up paper and plastic. The papers and plastic are put into plastic bags and are taken by a truck to where they are burnt. The collection of waste is done in the central business area and residential areas. He indicated that they "*do not sort the waste".*
Khaya	Emphasis on everyday / contextually derived waste management knowledge. Their activities are informed by contextual activities. Waste management practices are unacceptable: tins, plants and bottles placed in a hole and burnt. Burning is an unacceptable method of managing waste from a legislative point of view but in the absence of	Emphasis on everyday / contextually derived waste management knowledge. Activities at the school were influenced by the activities in their context. They included elements contained in the waste hierarchy. They reused the leftovers of the feeding scheme as food for domestic animals in	They had no access to waste management legal frameworks, which emphasise the waste hierarchy. Waste management activities at the project emphasise everyday knowledge more than scientific knowledge. There are no recycling facilities and there is no sorting of waste.

	infrastructure it better than littering. Practised composting and reuse but activities were related to contextual activities and areas Did not understand the scholarly/scientific way of dealing with tins, plastic and paper. Put together all types of waste into a hole to burn.	the surrounding households. They did not deal with scholarly knowledge in waste management as they were not aware of the legal structures to support waste management services.	
Lizo	Emphasis on everyday/ contextually derived waste management knowledge. They have knowledge of managing biodegradable waste and re-use. They throw biodegradable waste in the garden to fertilise the soil. They show elements of inadequate knowledge on their management practices. In the rural areas, there is lack of support structures and infrastructure for waste management. Because of lack of knowledge they end up using wrong methods of treating waste e.g. they burn waste. They cut thorny shrubs and throw them on the open spaces. They lack the knowledge of the fact that open spaces also need to be cleaned, and that they are not for dumping. They also lack knowledge of waste management hierarchy and legislation.	Emphasis on everyday / contextually derived waste management knowledge. In his school they put all the waste in a hole and burned it. No facilities to manage and treat the waste according to the prescribed legislation	In the project there were old cement bins. Most of them were broken. They are given plastic bags every morning for collecting waste. They claim that they are sorting the waste, but discovered that they mix products which are not supposed to be put together e.g. plastics and paper and bottles with tins. The waste hierarchy is still incomplete, because though the waste is separated it is still taken to the same destination – the tip. No landfill site.
Mfana	Emphasis on everyday/ contextually derived waste management knowledge. Good knowledge of treating and managing biodegradable waste and reuse. Inadequate practices for treatment of other waste streams due to lack of support structures,	Emphasis on everyday / contextually derived waste management knowledge. Good knowledge of treating and managing biodegradable waste and reuse Inadequate practices for treatment of other waste	Emergence of waste management specialist knowledge and knowledge of the waste hierarchy, procedures of waste management and waste management prevention (scientific/scholarly knowledge).

	infrastructure for waste management in rural areas, and knowledge of waste management hierarchy and legislation.	streams due to lack of support structures, infrastructure for waste management in rural areas, and knowledge of waste management hierarchy and legislation.	Knowledge of procedures and processes from collection to disposal are still lacking.
Sanda	Emphasis is on everyday knowledge. Waste management is influenced by the contextual practices. Composting through throwing biodegradable waste in the garden is key. She is not informed about what to do with non-biodegradable waste. They also bury it in the garden.	Emphasis is on contextual and everyday practices. Waste is put into a hole and burnt to prevent it from spreading in the veld. There is no infrastructure to promote the current ways of managing waste.	In town there is infrastructure in the form of bags, old bins and a truck for waste collection Also challenged by waste collectors (scavengers) who open the plastic bags while they have already tied them to collect recyclables in the form of cardboard and tins. Elements of the waste hierarchy are emerging but inadequate.
Bongi	Emphasis is on everyday knowledge more than scientific knowledge. Waste is inclusive of materials, which are a product of their contextual activities e.g poultry and goat farming. They throw agricultural waste in the gardens to promote fertilisation of the soil. They are still facing challenges with dealing with the recyclables. There are no recycling facilities. They sell them to collectors of steel.	Bongi's school was a tertiary institution within an urban area. The area had facilities to store the waste. Scavengers would come and collect the waste from the school. The grass was burnt as it is not collected by the municipality trucks In the school, there were facilities to support the scholarly knowledge and the practices prescribed in the waste management legal frameworks but they were practised by the workers and not by students. Grass and food are made available to other people to conserve. Tins are collected by people. Weeds are left to dry and then burnt.	In the project there is infrastructure in the form of bins, plastic bags, and a truck. The waste hierarchy is emerging. They collect the waste; put it in plastics, which are put into bins to prevent them from being torn by the dogs. When the plastic bags are full, they tie and prepare them for collection by the municipal truck. From the cement bins the municipal trucks collect it to the tip. No licenced landfill site. In this project at the level of the project, the waste hierarchy is emerging but it is incomplete. Waste is collected and disposed; only other activities of management, treating and the waste cycle are neglected.

6.4 SUMMATIVE DISCUSSION OF THE WASTE MANAGEMENT KNOWLEDGE EMANATING FROM THE INTERVIEWS FROM BOTH PROJECTS.

6.4.1 Waste Management Knowledge at Home

From the discussion of the interviews per case from both projects, it is clear that waste management practices performed at home emphasise knowledge emanating from their social aspects more than scholarly scientific knowledge. Waste management knowledge and practices are informed by contextual practices, which reflects life in rural areas, as explained by Mpako-Ntusi (2002) who noted that rural communities tend to practise subsistence farming for their livelihoods. Their waste management actions are related to their agricultural practices, for example, people throw the peels of potatoes and cabbages in the gardens as they act as organic material that fertilises the soil. They use most of the food remnants as food for animals such as pigs. Those who do not have animals give the remnants to neighbours, reflecting that the spirit of Ubuntu is still prominent in these practices.

In almost all stories, there was evidence that there was confusion about the properties of paper and plastic paper. Some burn paper, while others put it into holes and cover it with soil which is a form of composting. Most sort plastic and paper together. When they burn, they burn plastic and paper together and when they bury these forms of waste, they bury them together. They seem not to understand that they have different properties. What comes clearly into view is the fact most of the respondents and their families struggle with non-biodegradable waste like plastics, tins, and bottles – all are placed in a hole and burnt, but they subsequently discover that tins and glass do not burn. These are collected after burning (because they look old and rusty)and then thrown outside yards, sometimes into water courses. According to waste management knowledge, this is effectively a practice of 'illegal dumping'. From an organic waste point of view, people cut down thorny shrubs in their yards, leave these to dry and then throw them over the fence into unoccupied spaces next to the mountains, reflecting the "not in my backyard syndrome". Poor practices such as burning of waste are prominent.

As shown by almost all workers interviewed in Project 1 and 2, waste management activities from home emphasise everyday knowledge more than specialist scientific waste management knowledge. The social relation to the subject is thus more emphasised than the epistemic

relation to the object. The responses are influenced by the characteristics, attributes, background and the contexts of growth of the workers. The knower code (SR+/ ER-) is emphasised more than the knowledge code (ER-/ SR+).

6.4.2 Waste Management Knowledge at School

According to the evidence emerging from the data, most of the schools in the rural settings have holes for burning and burying waste which shows a lack of alternative infrastructure for waste management. Paper, broken window panes and plastic are thrown into the holes and burnt. From this, it is clear that the practices in the schools are influenced by practices in the surrounding homes and communities. In the schools, everyday contextualised knowledge of waste management is emphasised. Like at home, in the schools the social relations (SR+) to the subject are emphasised more than the epistemic relation (ER-) to the object. The knower code (SR+/ ER-) is emphasised more than the knowledge code (ER-/ SR+).

6.4.3 Knowledge in the Project

As mentioned above, the workers in the project were interviewed three weeks after they had joined the project. The aim of these interviews at the start of the project was to find out what waste management knowledge they were bringing from homes and schools to the project. It also helped me to identify the waste management knowledge emphasised in the project and to check if there was any clash or match between knowledge emphasised in workers' homes, previous schools and the project.

What emerged from this enquiry into waste management knowledge near the start of the project was that certain types of waste found in the homes were not found in the research towns. These types of waste included kraal waste, poultry, sheep and goat manure. Evidence emerging from the data shows that in both towns there was infrastructure in place for the management of waste. In the first town there were bins and steel cages. The bins are supplied with plastic bags. Every morning workers are supplied with plastic bags for picking up waste. In the second town there were cement bins though the workers reported that some of them were broken and there were no cages. Plastic bags were also put into these bins. In each town there was a municipal truck which was used for the collection of waste.

The workers noted that in the town there were different types of settlements: formal and the informal settlements. The formal settlements and the central business district (CBDs)

benefitted from an infrastructure which included municipal services, while the informal settlements did not. Workers noted that,

> *In the formal residential areas and CBD there are bins but people do not care. You would find that the bins are not full but the streets are dirty showing that they do not use the bins properly … Most of the time we get the plastics sunk in the bins, bins full as the people just throw their waste anyhow. The residents would say they are creating more work for us cleaners so that we do not lose jobs because of the reason that there is no waste.*

The evidence depicted above pointed out that the people's attitudes and behaviours influenced the status of waste within the towns.

What also emerged from the interviews was that there was routine work in the projects. The workers would collect waste, put it in plastic bags and place these in a cage or cement bin. From the cages and bins, the waste is collected by municipal trucks to the tip where it was burned.

In Project 1, the data indicated that there was an emergence of waste management specialist knowledge at the level of the project, which included aspects of the waste hierarchy inclusive of procedures and processes of waste management and that waste management prevention knowledge is emerging. Procedures and processes spread from waste avoidance and prevention, minimisation, reuse, recycling and sound environmental disposal in waste management facilities are gradually surfacing well but the influences of who the workers are, their prior knowledge and their background experience of waste management knowledge are still prominent. Their contextual related ways of doing things are still evident in their activities in the project. The workers claimed that they were sorting the waste but when the researcher looked closely into their sorting activities, she realised that their combinations were not acceptable according to waste management principles: "*We put bottles and tins together and put paper and plastics together."* Additionally, the municipal trucks collect the bags and take them to the tip where the waste is burned. .

One of the things which emerged as being significant in this data, was that there were no recycling facilities or properly licensed disposal areas in the area indicating poor waste management infrastructure in rural areas and rural towns. The participants indicated that they would like to have a place where they can sell waste but they had no transport facilities to Durban for recycling. Disposal sites are not structured according to the prescribed standards of

the National Waste Management Act. The landfill sites have no licenses as set up in the standards of the legal frameworks.

In the project sites, both epistemic and social relations were emerging as the basis of achievement at this level. The activities of the project were trying to expose the workers to the specialist knowledge in waste management (types of waste and the waste hierarchy) but the specialist legal frameworks (waste regulations and legal obligations of municipalities) were not put into practice in the activities of the towns. The social aspects and home practices of the workers were still dominant. There is a need for supporting workers to develop more in-depth understandings of the types of waste, classification and how waste is managed. Formal training is therefore crucial and it needs to interact with the workers' knowledge and the reality of the waste management situation as it is experienced on the ground in the projects. The availability of the legally prescribed infrastructure and recycling facilities is also key to these projects. In this section as well, the social relation to the subject SR+ is dominant while epistemic relation to the object ER+ is still emerging. The knower code is still emphasised more than the knowledge code. Evidence above indicates that the workers need to be exposed to specialised waste and waste management knowledge very early after the project has started.

6.5 CONCLUSION

This chapter investigated the knowledge which the workers bring from home, school and the projects (at the start of the projects) which influence the circulation of knowledge. The circulation of knowledge was investigated through the knowledge, dispositions and the experiences the workers bring to the project. The practices and actions in the early period of the project were also analysed. Bernstein's theory and Maton's legitimate code theory were utilised to interpret and trace the status and the development of waste management knowledge per case from home to the project, showing a strong social SR+ code as being dominant, with some emergence of a knowledge code in the early phases of the project.

As will be discussed further in Chapters 7 and 8, this understanding of workers' knowledge and experience of waste management can potentially inform the learning programme designs and qualification revisions and can also provide insight to trainers on how to contextualise training into semi-rural towns. It can also offer pedagogical insight to trainers, especially how

the knowledge prescribed in the unit standards (see Chapter 4) might be connected with what the workers already know. Lotz-Sisitka and Lupele (2017) and Shumba and Kampamba (2017) argued that for transformative learning to occur, there is need to give attention to 'learning as connection' which builds on Vygotsky's (1978) research which proposed that there should be attention given to the zone of proximal development of learners, which connects their everyday knowledge to more abstract forms of knowledge via mediation processes (see Chapter 8). While the unit standards support forms of contextualisation of knowledge as shown in Chapter 5, they are silent on the pedagogical dimensions of learning.

The chapter has also pointed to a code clash between the waste management knowledge brought by the workers from their previous life experiences and the waste and waste management specialist knowledge being promoted in the Field of Production and Field of Reproduction (see Chapters 4 and 5). The chapter has shown that there is a need for training of the workers on specialist waste management knowledge at the beginning of the project. There is also a code clash between the status of infrastructure in the rural towns when compared with the norms prescribed in the waste management frameworks which influences the knowledge that workers are exposed to. Even if the specialist knowledge was available, without the prescribed infrastructure, the exercise would be in vain. In the next chapter I consider how formal training and workers' informal learning experiences are shaped as the project progresses.

Chapter 7:

The Reproduction and Circulation of Knowledge in Waste Management Formal and Informal Pedagogic Interactions

7.1 INTRODUCTION

This chapter is the fourth of the chapters that report on the findings of this research. It focusses on the reproduction and circulation of knowledge in waste management formal and informal pedagogic interactions. Reproduction in this context originates from Bernstein's (1990) pedagogic device. As already discussed in Chapter 2 in section 2.3.4, the pedagogic device is comprised of three fields namely the field of production (see Chapter 4), the official and pedagogical field of recontextualisation (see Chapter 5) and the field of reproduction (this chapter, with Chapter 6 as a contextual background highlighting workers' knowledge of waste and waste management, prior to the training).

This chapter therefore focusses on the field of reproduction and maps how knowledge is reproduced via the actual training processes i.e. the teaching and learning activities in the EPWP programme. Circulation refers to the flow of knowledge between and amongst all the participants in the project whether in formal or informal settings. The chapter addresses the following two questions:

1. How is the knowledge reproduced and evaluated in the waste management EPWP training activities (formal) and workplaces (informal)?
2. How does waste management knowledge circulate amongst the workers in the EPWP training activities and workplaces?

As noted in Chapter 3 section 3.5.4, to investigate the reproduction and circulation of knowledge in waste management, observations of formal training activities and interviews with workers in workplaces were conducted. The training activities reported on this chapter represent the findings of the formal education interaction observations in one of the workplaces, while interviews in workplaces represent the insights emerging from informal learning in both workplaces. As explained in Chapter 3 section 3.5.4, workers were interviewed towards the end of the project to establish if any learning had taken place while they were

participating in the project and how the individuals themselves learned and used that knowledge.

In Chapter 2 in section 2.3.5.1, I discussed how Bernstein (2000)'s work on framing and Maton's (2013) work on specialisation and semantics provided descriptive and analytical tools to conceptualise the underlying principles structuring fields of knowledge and knowledge reproduction in pedagogic interactions. Bernstein's work focuses on the knowledge and structure of educational and discourses, their interactions and discursive practice. According to Bernstein (2000), agents possess both recognition and realisation rules. Recognition refers to people/ agents' ability to identify relevant meanings in the context they are dealing with and differentiate between contexts a learner is engaged in and not engaged in. Realisation refers to their ability to produce texts and communicate those texts according to what is expected within the context (Bernstein, 2000, p.18). Maton's specialisation and semantics dimensions are used here to identify the underlying principles shaping the training interactions and therefore also the circulation of knowledge. Specialisation (reported on in Chapters 4 from section 4.4 to section 4.5) brings out the basis of achievement within the waste management training activities within this programme while the semantics dimension of Maton's work (see sections 7.2 and 7.3 in this Chapter 7) is used to determine how knowledge is built and circulates via waste management pedagogic interactions in the EPWP training activities and workplaces.

7.2 CIRCULATION OF KNOWLEDGE IN THE TRAINING ACTIVITIES: A FOCUS ON PROVIDER 1'S TRAINING

Training activities focussing on waste management in one of the two expanded public work projects in focus in this study were observed. The training activities were based on Unit Standard 119555 and the mediation of the materials created for this Unit Standard (see Chapter 5). My observations therefore focussed on the mediation processes associated with use of these materials in this Unit Standard only, in line with earlier arguments for staying with this focus in the programme (see Chapter 5 in sections 5.2.2 and 5.2.3). In reporting on this in this chapter, I focus only on Provider 1's training interactions because, despite making the necessary arrangements, I was not able to observe Provider 2 training taking having arrived for the observations when the training was already completed. I was, however, able to interview the workers who had undergone training in the Provider 2 training context.

The training interactions that I describe below are offered in some detail to provide a 'window' into the approach to training and some of the dynamics of the training. Being able to observe training in Provider 2's case would have expanded on these insights, but as this was not possible, I share as much detail as I can on Provider 1's training to offer insight into how knowledge circulates through the training process.

In section 7.2 below I begin by discussing the observations that I made of the introduction to the training in the case of Provider 1, and some of the details of Unit 1 of the training. The rest of the training as it unfolded in the case of Provider 1 is discussed in more detail in section 7.3, where I describe sequencing, pacing and specialisation of knowledge at the level of reproduction, and section 7.4, where I discuss the circulation of knowledge using Maton's analytical tools focussing on semantics. Sections 7.3 and 7.4 therefore provide more depth of analysis, where the analytical tools of Bernstein and Maton are deployed to provide the language of description for explaining the details of the training processes within the wider interest focus of the study.

7.2.1 Observation of training (the case of Provider 1 only)

The observation of the training involved observation of the pedagogical practices or activities. The pedagogical activities are inclusive of reproduction and framing of knowledge. Reproduction entails how the knowledge is produced in the pedagogic practice while framing demonstrates the selection, sequencing and the pacing of knowledge. Selection made reference to who participated in the selection of the content of the lesson. Is it the teacher or the learners? Sequencing of knowledge entails the purpose of the lesson, the order of the content, and the ordering which refers to the order of presentation of knowledge (i.e. which concepts follow which) and the associated discussions associated with the content knowledge (Morais & Neves, 2001). Pacing of knowledge discusses the interactions and the relationships between teachers and students and amongst the students themselves. The sequencing may be explicit, layered and step by step while in other cases it may be implicit. In short, framing controls how the content is sequenced, the pace at which it is taught, and the levels of control teachers and students exert over the pedagogic process (Bernstein, 1971; Clarence, 2013).

The class in Provider 1's session was composed of about 25 learners who were EPWP employees in the WoW programme. The participants were seated at tables arranged on the side of the class parallel to each other and there was an empty space in the middle for the facilitator

to move freely. There was a table in front for the facilitator to sit and place her documents while training.

Each learner was supplied with a learner's and an assessors' guide. The learners' guide consisted of the content to be taught while the assessor's guide contained the exercises to be conducted after each section of content was discussed. As shown in section 5.3, the provider organised the unit standard content into five units. These units were planned and arranged according to the specific outcomes that are prescribed by the qualification designers (see Tables 5.3, 5.4 and 5.5 in Chapter 5). Whenever the learners were called upon to do exercises, they were referred to the assessors' guide. The details are discussed in further descriptions of the lesson below.

7.2.2 Summative Description of Provider 1's Lesson Process

The content of this module as indicated above is divided into units. It commenced with the introduction and from there progressed from Unit 1 to Unit 5 (full details are included in Appendix 12 on the CD Rom attached). In the introduction, the provider introduced the chapter by discussing the different types of waste which were presented as natural and human waste. In Unit 1, a new outcome "needs to be able to recognise environmental pollution risks" was introduced. It explains the relationship between pollution and waste which serves as a basis for introducing waste management. In Unit 2 the materials described the impacts of poor waste management on health and safety of both man [humans] and the environment. In Unit 3 the classification of waste was explained, inclusive of both general and hazardous waste. This was followed by an introduction of the waste hierarchy with each level being discussed at length. The unit standard is not explicit on waste hierarchy but it is alluded to in the assessment criteria of specific outcome 1 (see sections 5.3 and 5.4). In Units 4, 5 and 6, the provider discussed the elements of specific outcome 1 "separate, treat and store waste", namely waste storage, collection, transport and waste treatment (see also section 5.3, 5.4 and 5.5).

7.2.3 The Observed Classroom Interactions: An Overview of Content and Sequencing

The facilitator self-directed the lesson by means of questions. There were different types of questions asked in this lesson. Some of the questions were content related; they assisted the facilitator to engage the learners in interactions around the content she was trying to introduce and aided the facilitator to determine what learners already knew (diagnostic questions). I provide a detailed or "thick" description to illuminate the flow of knowledge between facilitators and workers in the training.

Introduction: The facilitator commenced by asking questions like: *"What is waste management and what is waste?"* There was no response from the workers. This gave the facilitator a chance to explain why it is critical for people to understand waste management. She explained how the world struggles with fighting the 'waste war', stating: *"The whole world today is struggling with the problems of waste management. It is important for us also to understand waste management systems to ensure that the level of waste in the world is decreased with its effects on the environment."*

The second group of questions and instructions were not related to the content. I call them administrative or 'learning support' questions. They were not related to the content but emphasised the expectations of the facilitator as the lesson progressed, for example:

> *"As we move forward there will be a lot of new terms. You need to write them down so that you develop a dictionary for waste management terms as we move forward. I shall explain some but others you will have to look for them in the English dictionary for you to understand what they mean. If I speak deep English please tell me and if you do not understand please talk … We shall discuss types of waste and the categories of waste. One needs to link these concepts as we move forward."*

From the interactions above it seems that the facilitator had planned an interactive lesson. She encouraged the learners to participate in the lesson by means of discussions but most of the time there were no responses from the learners. She opted to use stories to clarify issues, gave them examples related to their contexts and encouraged them to use their mother tongue. An example of a story told in an attempt to make a connection between what the learners know and what they do not know in their contexts, which connects the past and the present, is provided here, when she explained the difference between human waste and natural waste.

> *"We humans, there is additional waste that we accumulate: We humans changed our lifestyles. Long ago people were living a simple life. They were staying in houses made up of grass. People were close to nature and the environment. There was not a lot of waste. [Social & historical]*
>
> *New civilization came in and there was a move from this type of living to modern ways of living. Factories were established. Factories deposited their waste into the rivers and seas. The ships moving across the seas from different continents in the world deposited their waste in the sea water. The people were more concerned about the money and production than the earth. All the conveniences they enjoyed impacted on the environment. That is why we are experiencing a problem of waste.*
>
> *The neglect humans had of the earth impacted on the environment.*

She explained the complexity of production and how much waste is produced throughout the process by using an example that was visually available to the workers,

> *If I throw away this pen. It is not the only waste from the koki pen. There are other elements, which were put together in the factory in order to come up with a product which is a pen. Throughout those entire processes there are waste products which were produced.*

The facilitator read the content knowledge from the learner's guide and explained the contents to the class. At the beginning of Unit 1 she commenced by explaining how the documents work (the learners' guide and the assessors' guide) as illustrated in the discourse below:

> ***Unit 1:*** *Environmental pollution and types of waste*
>
> ***Facilitator:*** *Opens the assessor's guide. Please open your assessor's guide on formative assessment (question) on page 37. The one in the beginning of page 37. Do we all see it?*
>
> ***Students:*** *Yes*
>
> ***Facilitator:*** *The question says, "Discuss what pollution is" Unit one therefore deals with the answer to this question. There are three types of pollution. In your file after we have discussed the types of pollution you will discuss and answer this question. As you answer the question you need to give examples from your communities."*

From this, it is possible to see that the facilitator was sympathetic to learners' contextual or everyday knowledge as she noted that when they answered questions, they could relate their answers to their communities and also use their vernacular languages. Question answers did not only refer to what is given in the learners' guide, but also to what was being said by the facilitator.

Mediating concepts: The facilitator spent the rest of the training mainly mediating concepts. She commenced by using a diagnostic approach where she asked the learners what they knew about the concepts. After that she read and explained the different types of concepts (for example, pollution). She read the key concepts (air pollution, water pollution, land pollution) from the learners' guide and broke them down into simplified language. She used illustrative examples that linked to learners' contexts to clarify them before moving forward. She extended the concepts by giving their causes and characteristics and also linked them with other new concepts. This observation is displayed in the example of how she went about mediating the concept of land pollution presented below in more detail:

> ***Land Pollution***

Facilitator: *Land pollution is about the degradation of the land … [she then instructed them to underline degradation in their book] … What does degradation mean?*

Learners: *No answer*

Facilitator: *Degradation is when you spoil something and lowering its value. This one is happening on land and in the soil. This time our lifestyles impact on the soil through agriculture. The farmers want to get money out of their produce. They therefore use pesticides which degrade the soil. When the rains come the pesticides are carried by water into the rivers.*

Facilitator*: But there is another alternative. People today talk about organic farming … Is there anyone "Who knows organic farming"?*

Learners: *No answer*

Facilitator: *Organic farming is the growing of plants in a natural way without the use of pesticides and fertilisers. If you are a stock farmer, one grows his stock without using genetically modified plants foods and medicines. When we use genetic modified substances the consequences are that they impact on our health. The basic issue of waste management is to make us aware that we are responsible for our lives and everything we do has an impact on ourselves and the environment. Another cause of land degradation is mineral exploitation and waste disposal.*

From the above extract it is possible to see that the facilitator introduced the concept "land pollution" by explaining it using another concept which is degradation. She was then forced to explain the concept of degradation as the learners did not recognise it. She tried to explain how degradation takes place using a context that the learners might relate to, namely agriculture, and she went on to explain the impacts of pesticides on the degradation of land and water systems. She did not establish if learners had experience of working in agriculture and administering pesticides – a practice normally used in larger scale agricultural contexts but instead went on to elaborate an alternative to the use of pesticides via the introduction of a new concept, namely 'organic farming'. As she proceeded, she realised that the new concepts used in creating examples to try to contextualise the first concept within the contexts were also foreign to the learners. The facilitator thus had to explain them using more examples. Though not planned, the challenge experienced brought the positive dimension of the lesson content being expanded through the linkages which came up between concepts.

After discussing the concepts within each unit, the learners were broken into groups and given an exercise to discuss:

Facilitator*: "Now it is time for group work. Turn to page 37 of your formative assessment book".*

Task: *"Discuss the three types of pollution. Bring up your own examples of pollution from your communities".*

Instructions: *"Do not use the ones I have discussed with you and the ones in the learners' guide.*
Write your deliberation on the sheet of paper.
Each group will nominate a person to come and report in front."
Facilitator distributes the sheets of paper and koki pens (explains the exercise).

Report back: During reporting, the whole group came to the front and one of the learners reported. At the end everyone asked questions of the group (the facilitators and members of the other groups).

The reports of the groups are presented below in Table 7.1.

Table 7.1: Report backs by groups

Report presented by Group 1: *Activities performed which impact on the environment*	***Report presented by Group 2:*** *Activities performed which impact on the environment*
Air Pollution*: In our group we looked at examples in our communities:* 1. *The people put their waste in dustbins. When they are full they take it out and burn it. The smoke comes out and spoils the air.* 2. *Digging of the soil using machinery. Roadworks, power station and digging of crushed stone for construction creates air pollution.* 3. *Veld burning contributes to smoke/smog in the air.* 4. *Dead animals pollute the atmosphere with bad odours.*	***Air Pollution****:* 1. *In our area the landfill site is situated not far from the Black residential area. There are few recyclers and they recycle only cardboard and bottles. Other recyclables are not recycled, they are burnt. The smoke comes out and disturbs the nearby areas. A smog develops and is detrimental to the environment and the nearby schools and residential areas.* 2. *Effluent from factories.* 3. *Tyres: small businesses next to the road burn their tyres and spoil the air.* 4. *Veld burning affects the air. We lose our animals because of choking.*
Land Pollution 1. *Mineral exploitation: they dig and spoil the land, making crushed stone, toilets and Eskom poles.* 2. *Degrade the soil by causing dongas and soil erosion.* 3. *Manual digging and utilisation of homemade sewage systems as the people do not have machinery. Their activities spoil both the land and the air.*	***Land Pollution*** 1. *Waste spoils the land. It becomes a dumping site. Moisture and water make the place unusable. Children develop rashes and sores.* 2. *Big trucks carrying hazardous materials are involved in accidents. The oils spoil the grass and the road. The spills burn the grass and the spills cause more accidents on the roads.*

In the exercise the learners were requested to come up with examples from their own contexts. The reports of both groups are listed above with examples from their own contexts. The sequence of the class activities was arranged in carefully planned steps namely introduction, reading from the learners' guide, discussion of concepts, discussion of content in groups and coming up with examples from their contexts.

7.3 FRAMING, SEQUENCING AND SPECIALISATION OF THE KNOWLEDGE AT THE LEVEL OF REPRODUCTION

7.3.1 Framing and Sequencing of the Training

As discussed in section 2.3.5.1, framing in pedagogic practices may be stronger or weaker (Bernstein, 2000). It is strongly framed when the locus of control over pacing, sequencing and evaluation of knowledge lies primarily with the teacher, as is the case in the lesson process of Provider 1 outlined above (F+). It is weakly framed when the control over the pacing, sequencing and evaluation of knowledge is conducted by the students, as appears to be the case in the lesson process outlined above (F-). The description of framing by Bernstein (1971, 1990), however, would appear to indicate that there are only two categories of pedagogic practices i.e. either be strongly framed (teacher-centred) or weakly-framed (student-centred). Pedagogical practice shaped via explicit teacher control is also known as visible pedagogy while pedagogical practice shaped via implicit teacher control is known as invisible pedagogy. Visible pedagogies are most often comprised of traditional, teacher-centred, subject-knowledge based teaching methods (e.g. in the case above where the emphasis was on structured activities and approaches to teach specific waste management concepts), whereas invisible pedagogies tend to represent more progressive, student-centred, interdisciplinary knowledge-oriented approaches that are also often times more applied or emergent out of practice (Marais & Neves, 2001). As can be seen from the lesson process above, there were some elements of engaging the learners in dialogue and drawing on their experience, which indicates at least some leaning towards the latter approach.

Huba and Freed (2000, as cited by Morais, Neves and Pires, 2004) offered an heuristic which helps to make the characteristics of teacher and learner-centred pedagogical approaches more explicit. I used these characteristics (see Table 7.2.) to reflect a bit more carefully on the pedagogic practices observed. Table 7.2 contains the perspective of Huba and Freed (2000). I reviewed the pedagogical process, and indicated those that were observed (as described above) using bold text. The result of this, as can be seen in Table 7.2, shows that the boundaries

between teacher-centred and learner-centred approaches can be somewhat blurred, even when there is a dominance of one particular orientation to the overall pedagogical process. There are elements of transfer of knowledge from facilitator to students (leaning more towards teacher-centred orientations and strong framing) and elements of interactions between students and the facilitators (leaning more towards student-centred orientations and weaker framing). This shows that the strength of framing can shift within a particular learning process as the lesson progresses.

Table 7.2: Teacher-centred vs. learner-centred orientations (Source: Learner-Centred Assessment on College Campuses by Huba and Freed, 2000)

Teacher-centred	**Student-centred**
Knowledge is transmitted from professor to students	Students construct knowledge through gathering and synthesising information and integrating it with the general skills of inquiry, communication, critical thinking, problem solving and so on
Students passively receive information	**Students are actively involved**
Professor's role is to be primary information giver and primary evaluator	Professor's role is to coach and facilitate
	Professor and students evaluate learning together
Teaching and assessing are sometimes separate	**Teaching and assessing are sometimes intertwined**
Assessment is used to monitor learning	**Assessment is used to promote and diagnose learning**
Emphasis is on acquisition of knowledge outside the context in which it will be used	**Emphasis is on using and communicating knowledge effectively to address enduring and emerging issues and problems in real-life contexts**
Focus is on a single discipline or **topic (i.e. waste management concepts and waste hierarchy knowledge in this case)**	Approach is compatible with interdisciplinary investigation **(partly)**
Culture is competitive and individualistic	**Culture is cooperative, collaborative, and supportive**
Listening	**Students construct knowledge by integrating new learning into what they already know**
• Reading	
• Independent learning, often in competition for grades	**• Learning is viewed as a cognitive and social act**
Pedagogy is based on delivery of information via Course Design and delivery structure (i.e. the strong	Pedagogy is based on engagement of students

influence of the Unit Standard requirements and outcomes in this case) **• Lecture** **• Assignments and exams for summative Purposes**	**Active learning** **• Assignments for formative purposes** **• Collaborative learning** • Community service learning **• Cooperative learning** • Online, asynchronous, self-directed learning • Problem-based learning

As indicated above, the facilitator is the overall knowledgeable figure in this lesson sequence and she directs the activities of the lesson. She does not only engage in one-way knowledge transfer, however, and encourages and structures the lesson in ways that allow learners to participate actively in the lesson process by asking them questions, engaging them in discussions and by giving them group tasks that require them to come up with presentations relevant to their contexts and present this collective effort as groups. Despite this, the approach to teaching is not completely 'student-centred' to the extent of allowing students more control over the pacing and sequencing of knowledge in the pedagogic practice and topics for discussion. Their role is limited to scripted participation in activities guided and suggested by the facilitator, even though the learners do not participate in these scripted activity invitations all the time. This non-responsiveness at times serves to create a situation where the facilitator is constantly put in the position of needing to direct all the activities. This indicates that the framing of the pedagogic process in the case of Provider 1's Level 2 waste management training programme is stronger (F+) as the pacing and the sequencing is more or less fully controlled by the facilitator. This pattern is based on principles of specialisation and semantics, which will be illuminated through further analysis below in sections 7.3 and 7.4.

7.3.2 Specialisation of Knowledge at the Level of Reproduction

Specialisation at this level is diagnosed by finding answers to the following question. "What is emphasised in the training of workers at the level of reproduction or what is the basis of achievement at the level of reproduction?" As noted in Chapter 3 section 3.4.4 the pedagogic activities in the project were observed and video-taped which I transcribed . I analysed the transcripts to make sense of the knowledge the provider emphasised as the basis of achievement. I coded the information, identifying the different knowledge emphasised. I then

drew up a table showing the different types of knowledge emanating from the class interactions (see Table 7.3).

Table 7.3: Types of content knowledge identified in the observation of training in Project 1

Type of knowledge	What it entails	Some indicators from the data
Specialised knowledge	Environmental knowledge and waste management knowledge Propositional, processes, skills and procedures in waste management	Waste is divided into two different types namely natural waste and human waste. Natural waste develops naturally from living organisms (concept) There are three types of pollution: air, water, and land pollution Definitions: Air Pollution is the accumulation in the atmosphere of substances that in sufficient concentrations, endanger human health or produce other measured effects on living matter. [see lesson detail below for further definitions of concepts] Waste classification and waste management: Waste is classified into two main categories, namely general and hazardous waste. Skills & procedures: Steps of waste management systems in South Africa: Avoid creating waste The 4 Rs are :- Reduce, Reuse, Recycle and Recover Waste can be reduced by: Reducing what we consume Reusing items several times Recycling those things that cannot be used Recovering energy from waste that is burnt, or that rots If waste is not treated it becomes a hazard Waste has impacts - they are severe on old and young people
Social knowledge	How people's attitudes and behaviours impact on promoting waste generation and management	Low population rates also assist in protection of the environment The neglect humans had on the earth impacted on the environment F: There is a belief that waste management is the responsibility of government. "Yes I understand in terms of the laws and providing infrastructure but when it comes to individual households it is up to us to protect, prevent and practise good waste management – so it becomes everyone's responsibility" Chemicals used by people in gardens. They utilise them to increase their produce for commercial purposes but they are detrimental to their health and the environment. We humans changed our lifestyles. Long ago people were living a simple life. They were staying in houses made of grass. People were close to nature and the environment. There was not a lot of waste. (Social) All the things are influenced by our practices which are detrimental to man and the environment.

Legal knowledge	Pertains to issues that address needs relating to waste management regulations, norms and standards	**National Environmental Management Act (NEMA) (principles of NEMA from 108- 112)** This is the act used in South Africa to promote environmental principles. It propagates the protection of the environment from generation to generation. **Principles of NEMA:** Cradle to grave: each one is responsible for the management of his/ her waste from the start to the finish. e.g if one is manufacturing a pencil, one should be responsible for the waste that comes out as the process which unfolds from the start to the end. Polluter pays: Whoever is responsible for the waste should pay for prevention and the restoration of the environment if a problem arises e.g when there have been oil spills in the sea. The polluter would need to pay for the cleaning of the penguins and the sea when the oil spills have taken place in the sea. **Roles of Municipalities** At municipal level there are acts dealing with protection of the environment but they need not be contrary to NEMA. The municipal laws are listed on page 19.

As shown in Table 7.3 above, in the pedagogic activities the provider emphasised three aspects, namely specialised knowledge, inclusive of propositional knowledge, skills, processes and procedures of waste management, social aspects of waste management and the legal frameworks in waste management. In propositional, skills, processes and procedures she placed emphasis on the explanation of terms, for example, what is waste, types of waste, classification of waste categories, types of pollution air, water and land. As she progressed she gave the examples of each from the context. As she progressed with the explanation of terms, she connected them with what she called, "the waste management systems of South Africa" which were discussed and are comprised of the waste hierarchy, definitions of processes contained in the waste hierarchy, giving examples. She connected the waste terms and the processes and procedures of the waste hierarchy with national and local government legal frameworks. The legal frameworks made reference to the National Environmental Management Act (NEMA) principles relating to waste and the municipal laws.

The third type of knowledge she emphasised was social knowledge and in every unit, she emphasised that waste is the responsibility of every human being and how the humans impact on waste and waste management. Additionally, she also emphasised the application of the knowledge in contexts of the workers in every unit, seeking to contextualise the knowledge.

Using Maton's legitimation code theory I now try to explain the underlying principles determining what is emphasised. In Maton's theory (2004, 2006, 2008, 2010, 2013) specialisation looks at what makes something or someone different, special or worthy of distinction. It highlights that every knowledge claim is about or oriented towards something or by someone, reflecting either an epistemic relation to the object or a social relation to the subject/ actor or agent (Maton, 2010, pp. 44- 45). Different practices may emphasise these two relations differently and these may be stronger + or weaker -. As already discussed and illustrated in previous chapters, knowledge can be seen as specialised by its epistemic relation or by its social relation, and in the field of production and most of the associated recontextualisation processes analysed so far, the epistemic relation (ER+) was stronger than the social relation (SR-) in waste management knowledge oriented towards the training of Level 2 workers, except their own knowledge experience, which reflected a SR+ code.

The analysis of the pedagogic practices of Provider 1 illustrates that both social and epistemic relations are emerging in these practices. The epistemic relations to the object are inclusive of the specialised waste management knowledge which is comprised of the knowledge of (propositional) waste management skills, waste management processes, waste management procedures and legal frameworks knowledge, while the social code is represented by the impacts of humans on the environments and the reference to human contexts. In these pedagogic practices at Level 2 of the NQF, the knowledge code (ER+) is emphasised as the facilitator and the programme itself still aim to primarily support the workers to understand the concepts and the legislative processes in this field. The epistemic relation to the object is therefore stronger than the social code (SR) which is therefore weaker (SR-).

7.4 CIRCULATION AND BUILDING OF KNOWLEDGE AT THE LEVEL OF REPRODUCTION USING SEMANTICS

7.4.1 Recapping the Theory of Semantic Density and Semantic Gravity

The last question answered in this chapter is about how waste management knowledge circulates amongst the workers in the training activities and workplaces in the EPWP projects. It has been proposed that semantics, which is one of the dimensions of Maton's legitimation code theory can be utilised to analyse the circulation of knowledge (see section 2.3.5.4). Maton refers to this as "knowledge-building" (Maton, 2013, p. 1). Maton (2013) asserted that knowledge building can either be cumulative or segmental. It is cumulative when it enables students to build on previous understandings and allows them to transfer what they learn to the

future. It is segmental when it is strongly tied to that context and only meaningful in that context.

As mentioned in Chapter 2 in the last paragraph of section 2.3.4.5, semantic gravity and semantic density originates from Bernstein and Hawkins' work. It makes use of the terms of context dependence and independence as well as issues of condensation of meaning and non-condensation. As discussed in Chapter 2, semantic gravity refers to the degree to which meaning relates to its context. Semantic gravity may be relatively stronger (SG+) or weaker (SG-) along a continuum of strengths. The stronger the semantic gravity (SG+), the more meaning is dependent on its context. The weaker the semantic gravity (SG-), the less dependent meaning is on its context. How strengths of semantic gravity are determined and realised depends on the specific object of study, for example, in biology the name of a specific plant in biology embodies a stronger semantic gravity than processes such as photosynthesis. In waste management, for example, paper has a stronger semantic gravity than a category of waste such as general waste. One can use these semantic types to discuss the changes in knowledge over time in a pedagogic activity. They can also be used to describe processes of weakening (SG-) and strengthening (SG+) of semantic gravity. Weakening of semantic gravity is the movement from concrete to generalisations or the abstract. Strengthening of semantic gravity entails the movement from abstract or generalisations to the concrete (Maton, 2013, pp. 9-11).

Semantic density refers to the degree of condensation of meaning within socio-cultural practices. It may be relatively stronger (SD+) or weaker (SD-) along a continuum of strengths. The stronger the semantic density (SD+), the more meaning is condensed within practices. The weaker the semantic density (SD-), the less meaning is condensed. The degree of condensation relates to the semantic structure in which it is located. A semantic density may be strengthened (SD+) or weakened (SD-). Strengthening of a semantic density refers to moving from a symbol that denotes a small number of meanings to one with a greater number of meanings. Weakening of a semantic density means moving from a highly condensed symbol to one that involves fewer meanings (Maton, 2013, p. 12).

Maton (2013) indicated that all empirical practices have semantic density and semantic gravity but it is only a matter of differences in strengths. The strengths provide basis for typologising practices and also embrace differences between and within the different forms of practices. They also depict how the practices change over time. Strengthening and weakening of semantic gravity and density enables researchers to trace the semantic profiles of practices over time and

the semantic ranges between their highest and lowest strengths. As argued in Chapter 2, this is why I have opted to use semantics in this research. I reasoned that it would assist me to outline the characteristics of the teaching and learning practices in the EPWP training activities and how knowledge within them develops over time. Before going into a more detailed analysis of semantics in the Provider 1 training processes, I provide an explanation of the different parts of a semantic profile as I will be using these for further explanation.

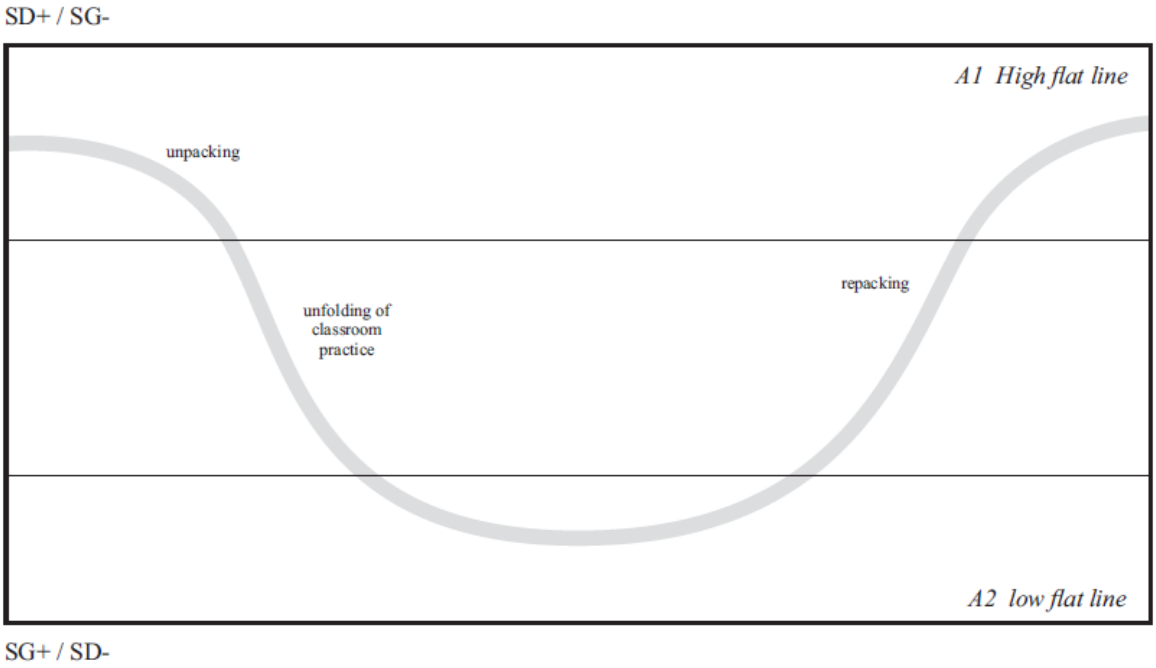


Figure 7.1: Drawing of a semantic profile involving semantic gravity and semantic density profiles

The low flat line is called A2 and it shows the level of stronger semantic gravity (SG+) where meaning is more dependent on its context and the level of weaker semantic density (SD-) where meaning is less condensed into concepts or terms. The high flat line is called A1 and it shows the level of weaker semantic gravity (SG-) where meaning is less dependent on its context (decontextualised) and the level of stronger density (SD+) where meaning is more condensed within concepts and terms. The semantic wave is labelled as B and shows the unfolding of a classroom practices and the flow of these, which is how concepts are unpacked and repacked (i.e. mediated) in classroom practice.

Repacking occurs when a concept is applied in a way which enables an upward shift towards the upper flat line. There are also down escalators which occur when down movements occur from the high flat line to the low flat line. They occur when abstract technical concepts are

unpacked using everyday language so that the students understand what the concepts mean. These are not the only ones; there are different types of semantic profiles or waves depending on the interactions within a classroom practice. They are comprised of downward and upward shifts which depend on interactions within that particular classroom practice. The ones found in the analysis of the waste management classroom practice of Provider 1 that I observed are explained and illustrated below using this approach to representing semantic density and gravity patterns and shifts.

7.4.2 Semantic Gravity and Density as observed in Provider 1's Pedagogical Practice

In this section I discuss, through the use of semantic codes and semantic waves, how knowledge circulates or is built in the waste management training activities observed within the EPWP project training of Provider 1.

7.4.2.1 Introduction of the lesson: Introducing the concepts waste and waste management

I begin with re-visiting the introduction of the lesson, which I described above, but this time I show the semantic profile for the introduction of the lesson in Figure 7.2. The facilitator introduced the concepts of waste and waste management. In the first lesson of this unit standard or module, the facilitator commenced by asking the following question:

> ***Facilitator:*** *"What is waste management and what is waste?"*

As mentioned above, there was no response in the form of an answer from the workers. The meaning of these two concepts are highly condensed and are also decontextualised. They are therefore situated at level A1 or the high flat line. The facilitator started by explaining the context, why it is critical for people to understand the concepts and the processes of waste management. She mentioned that the whole world today is struggling with waste and it has an impact on the environment and explained it further by means of a picture. Extracts from the data illustrate this:

> ***Facilitator:*** *"It is important for us also to understand waste management systems to ensure that the level of waste in the world is decreased with its effects on the environment".*
>
> [She showed a picture of a child surrounded by all sorts of waste and indicated that waste is present in all the environments. She explained the scenario].
>
> ***Facilitator (pointing to the picture):*** *"This is happening in the sea in India. The child is fishing. The sea is full of litter. When it rained the waves collected all the waste from the land, and it has developed into a waste island. Just think how are the fishes below that cloud of waste. 70% of that waste comes from the land."*

The facilitator used the picture to move from the high flat line to the low flat line. In Figure 7.2, this is illustrated by the downward wave from up to down (downward escalator). The facilitator weakened the semantic density and strengthened the semantic gravity by means of a picture via which she unpacked the two concepts, waste and waste management. She further unpacked the concepts by giving examples which show the effect of waste in the environment. She strengthened semantic gravity of the concept of waste management further by the use of the examples, as shown by this extract from the data which also refers to the picture:

> ***Facilitator (still pointing at the picture):*** *"Look at the example of the fridges which were thrown into the sea, they used to have mercury in them. Fishes would be affected by the mercury and people would eat the fish. They would get sick. Everything we do impacts on us and the environment".*

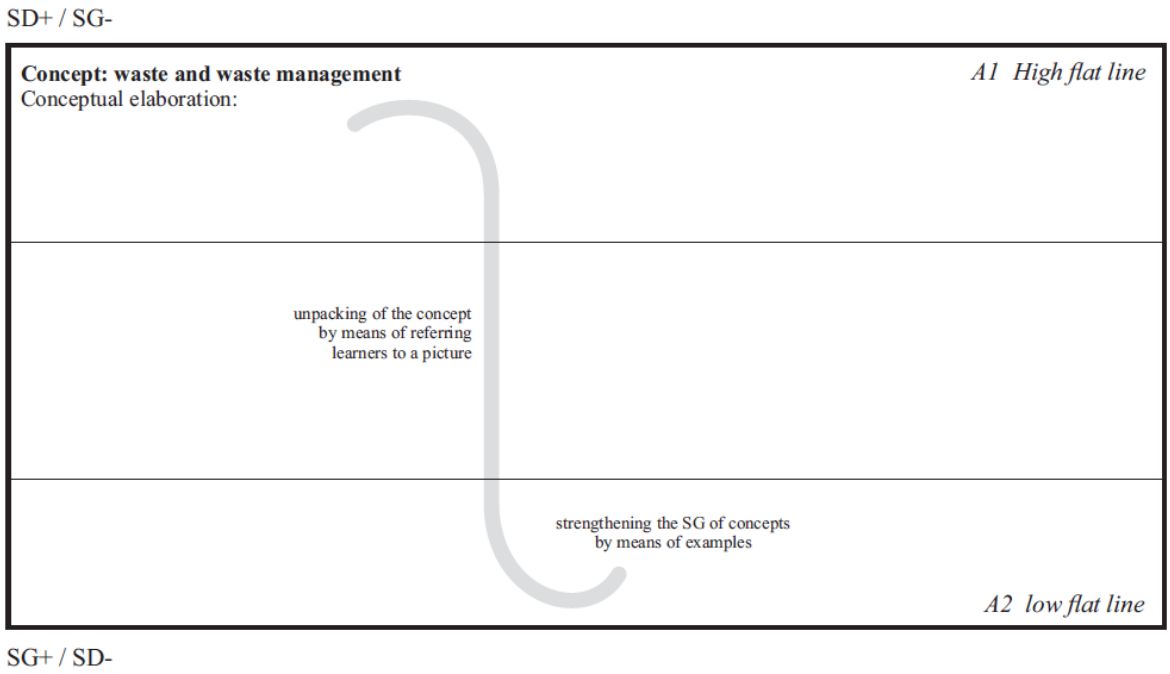


Figure 7.2: Semantic profile of the lesson introduction

7.4.2.2 Explicating different types and categories of waste

This was followed by classroom interactions which further illustrated and explained the concept of waste and waste management by explicating the concept further through referring to and introducing learners to different types and categories of waste. The following extract from the data shows these interactions, which are then illustrated in Figure 7.3.

> ***Facilitator:*** *"We shall discuss types of waste and the categories of waste."*

Facilitator: *"One needs to link these concepts as we move forward … Waste is divided into two different types, namely natural waste and human waste. Natural waste develops naturally from living organisms [**concept**] … For example to sweat involves decomposition. When a dog dies it decomposes and goes back to nature naturally [**examples**] …*

[She goes on to explain the difference between human waste and natural waste].

Facilitator: *With humans there is additional waste that we accumulate [**concept**]: We humans changed our lifestyles. Long ago people were living a simple life. They were staying in houses made up of grass. People were close to nature and the environment. There was not a lot of waste. [**broad social and historical contextualisation**] …New civilization came in and there was a move from this type of living to modern ways of living. Factories were established. Factories deposited their waste into the rivers and seas. The ships moving across the seas from different continents in the world deposited their waste in the water [**contextual examples to elaborate, rather than explain the concept**]. The people were more concerned about money and production than the earth. All the conveniences they enjoyed impacted on the environment. That is why we are experiencing a problem of waste [**concept**] …*

Facilitator: *The neglect humans had on the earth impacted on the environment [**concept**]. For example, If I throw away this pen. It is not the only waste from the koki pen. There are other elements which were put together in the factory in order to come up with a product which is a pen. Throughout those entire processes there are waste products which were produced [**explained the complexity of production and how much waste is produced throughout the process using a visible object as a practical example – the koki pen**].*

The classroom interaction above is illustrated below by means of semantic waves in Figure 7.3.

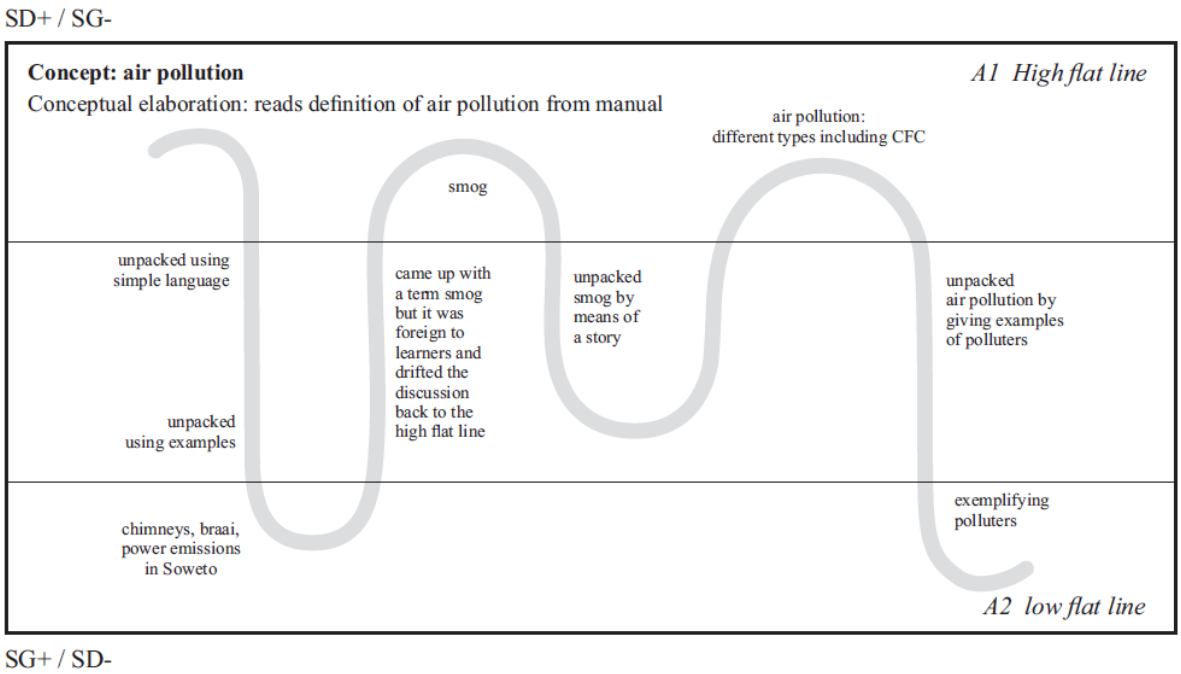


Figure 7.3: Semantic profile of the discussion on types and categories of waste

As indicated above in the overview of the lesson, and as can be seen in Figure 7.3, the facilitator planned an interactive lesson. She encouraged the learners to participate in the lesson by means

of discussions and stories, but sometimes there were no responses from the learners. She gave them examples related to their contexts and encouraged them to use their mother tongue. In the discussion of air pollution the facilitator introduced the lesson with a concept of *different types of waste* and she differentiated *human and natural waste*. These two concepts are condensed with meaning and located in the high flat line. She had to unpack them by using simple language:

Facilitator: *"Natural waste develops naturally from living organisms (concept)".*

As can be seen in the data extracts above, she unpacked the concepts by using examples. The examples strengthened the conceptual explanation to reach A2, the low flat line, where concepts are context dependent. In her examples she used the illustration of sweat and the decomposition of a dog's body to illustrate the concept of *natural waste*. In these examples (i.e. as she was trying to illustrate the concept of natural waste), she introduced another concept, namely *decomposition* which is highly condensed with meaning which drifted the discussion back to the high flat line. Next she had to unpack decomposition by using an illustration of what happens to a dog when it dies. She then had to repack from the illustration of the dog's body decomposing to the high flat line to unpack the second concept she was trying to introduce, namely *human waste* which she did through using a broad social and historical explanation of the changes in human lifestyles over time. The illustration showed changes in people's lifestyles. Workers have experienced such *change of lifestyles* in their contexts, so this takes the unpacking of the concept to the low flat line.

The discussion of natural and human waste thus shows a semantic profile with a movement of waves up and down which illustrates that in this interaction there was unpacking and repacking of concepts, as well as attempts to contextualise the more densely constituted meanings of the concepts. The semantic wave pattern shows a linkage between highly condensed concepts which forced the facilitator to unpack them to reach lower semantic gravity at the low flat line, before repacking the concepts to reach the next more condensed set of meanings which in turn had to be unpacked again to reach lower semantic gravity. While this pedagogical practice was taking place in attempts to support epistemic access, it was not clear whether this in fact supported the learners to access these concepts adequately.

7.4.2.3 Unit 1: Environmental pollution and types of waste

The facilitator commenced by using a diagnostic approach, asking the learners what they knew about the concepts of air, water and land pollution. There was not much response from learners and she then commenced with working through the definitions of the concepts from the manual, interspersing them with examples from context. I discuss these as the lesson progressed, showing the emerging semantic profiles associated with the different parts of the lesson.

Example 1: Air pollution

She started by reading the concept of air pollution from the manual and then explained it using simplified language and examples, as illustrated in the data sequence below and in Figure 7.4.

> **Facilitator:** Reads the key concepts (air pollution) from the learner's guide and breaks them down into simplified language
>
> ***Facilitator reads the definition:*** *"Air pollution is the accumulation in the atmosphere of substances that in sufficient concentrations endanger human health or produce other measured effects on living matter and other materials.* ***[concept]***
>
> ***Facilitator explains the concept in simpler language using an illustrative example in simple words:*** *"When something is classified as pollution, the level of the concentration of substances in the air is measured".*
>
> ***Facilitator gives further examples to illustrate the concept of different types of air pollution:*** *"For example, there is a difference in the level of accumulation between a braai [barbecue] and from chimneys".****[examples]***
>
> ***Facilitator goes on to explain further:*** *"The accumulation of substances from chimneys of factories is very high and therefore can be classified as air pollution. For a substance in the air to be classified as pollution it needs to be highly concentrated. Air pollution from a braai, when compared with air pollution from factories, is not concentrated.* ***[examples]***
>
> ***Facilitator gives an example****: "It [air pollution] is generated from power emissions, for example Soweto in winter is covered with a smog.* ***[an example that brings a new concept 'smog' into view]****.*
>
> ***Facilitator asks a question:*** *Do you know what the smog is?*
>
> ***Students:*** *No answer*
>
> ***Facilitator uses an example to illustrate / explain the concept of smog with simpler illustrative language:*** *"The smog is the black smoke which covers the whole of Soweto in the mornings and afternoons. I do not know if it is still there. The people of Soweto used to use coal stoves for fuel. The home owners were buying coal and every house was making coal fires in the mornings and afternoons, the smoke from those fires was causing the pollution of the air."* ***[example]***
>
> ***Linked to this, facilitator explains the concept of causes of air pollution using examples:*** *Other causes of air pollution are burning of solid waste, industrial processes and transportation. The roads are always full of cars and the people are not sharing transport, they*

are travelling one by one in their cars. There is a lot of traffic. The exhausts of the cars produce emissions. That is why petrol was changed from leaded to unleaded. To decrease the emissions a lot of things have been changed. ***[Examples of causes of air pollution]***

Linked to this, she starts to talk about emissions from CFCs in fridges: *The fridges have been changed to ordinary fridges from CFC fridges* ***[she does not explain what CFC is]****. Even the ladies and cleaning sprays today contain no CFCs to prevent the pollution of the air* ***[examples]****. Our lifestyles impact on the environment that is why we need to be aware.*

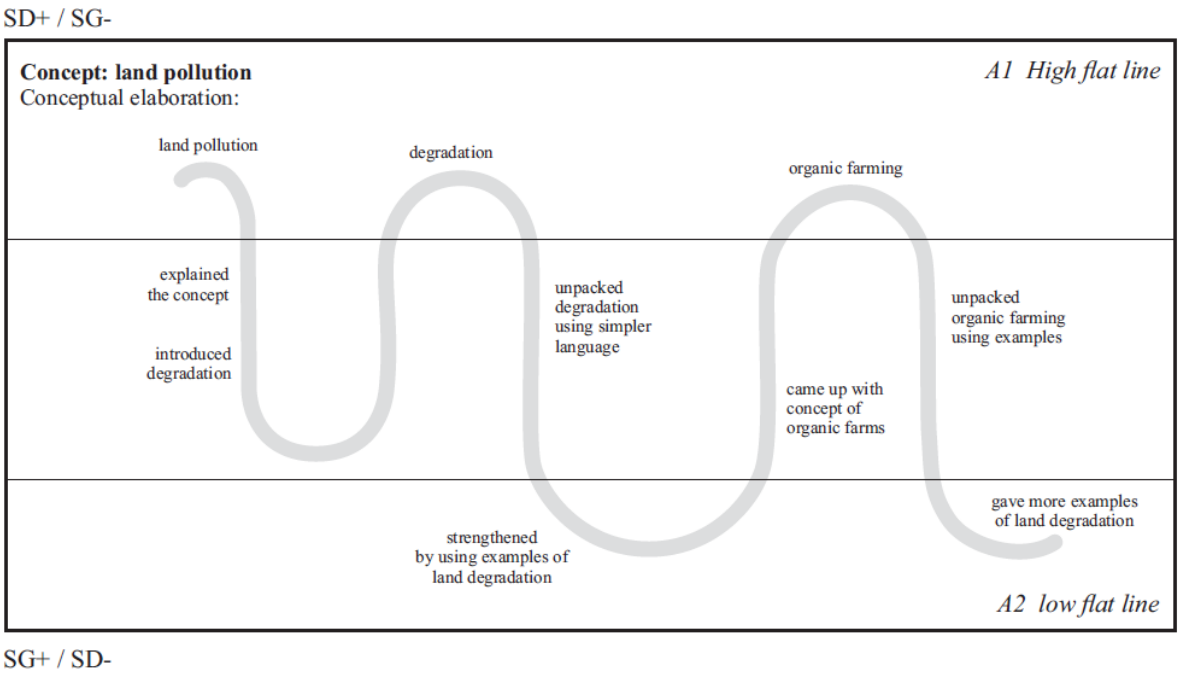


Figure 7.4: Semantic profile of the discussion on air pollution

As shown in this profile, after introducing a concept, the facilitator used illustrative examples from contexts to clarify the concepts before moving forward shifting from high semantic density (SD+) to low semantic density (SD-), or from low semantic gravity (SG-) to higher levels of semantic gravity (SG+). She extended the concept by giving its causes and characteristics or by linking it to other new concepts. The discussion of air pollution shows a profile with a repeating movement from the high flat line (SG-/SD+) to the low flat line (SG+/ SD-) which illustrates that in this interaction there was unpacking by the use of simpler language and repacking as a result of the introduction of new concepts (e.g. smog; different types of pollution) which were introduced via the previous examples. However, the contextual references were not all familiar to the learners as, for example, smog in Soweto was not from their own context but from a context in Johannesburg, thus the concept remained opaque and dense. This created the need to repack the term to the high flat line by introducing different types of air pollution and to unpack this further by means of a story, repeating the semantic wave pattern.

Example 2: Land pollution

The facilitator started this section by reading the definition of *land pollution* from the manual, and asking the learners to underline an associated concept, *degradation.* Like in the case of air pollution above, she used examples to help mediate concepts, which in turn introduced new concepts, as shown in this data sequence below, and in Figure 7.5.

> ***Facilitator reads from manual and asks learners to underling an associated concept, and then asks a question:*** *"Land pollution is about the degradation of the land. Underline degradation. What does degradation mean?"*
>
> ***Learners:*** *No answer.*
>
> ***Facilitator explains the concept using examples:*** *"Degradation is when you spoil something and lowering its value. This one is happening on land and in the soil. This time our lifestyles impact on the soil through agriculture. The farmers want to get money out of their produce. They therefore use pesticides which degrade the soil. When the rains come the pesticides are carried by water into the rivers."*
>
> ***Facilitator explains further and introduces a new concept:*** *"But there is another alternative. People today talk about organic farming."*
>
> ***Facilitator asks a question:*** *"Is there anyone who knows organic farming?"*
>
> ***Learners:*** *No answer.*
>
> ***Facilitator explains the concept using further examples, which in turn introduce new concepts:*** *"Organic farming is the growing of plants in a natural way without the use of pesticides and fertilisers. If you are a stock farmer, one grows his stock without using genetically modified plants foods and medicines. When we use genetic modified substances the consequences are that they impact on our health. The basic issue of waste management is to make us aware that we are responsible for our lives and everything we do has an impact on ourselves and the environment. Another cause of land degradation are mineral exploitation and waste disposal."*

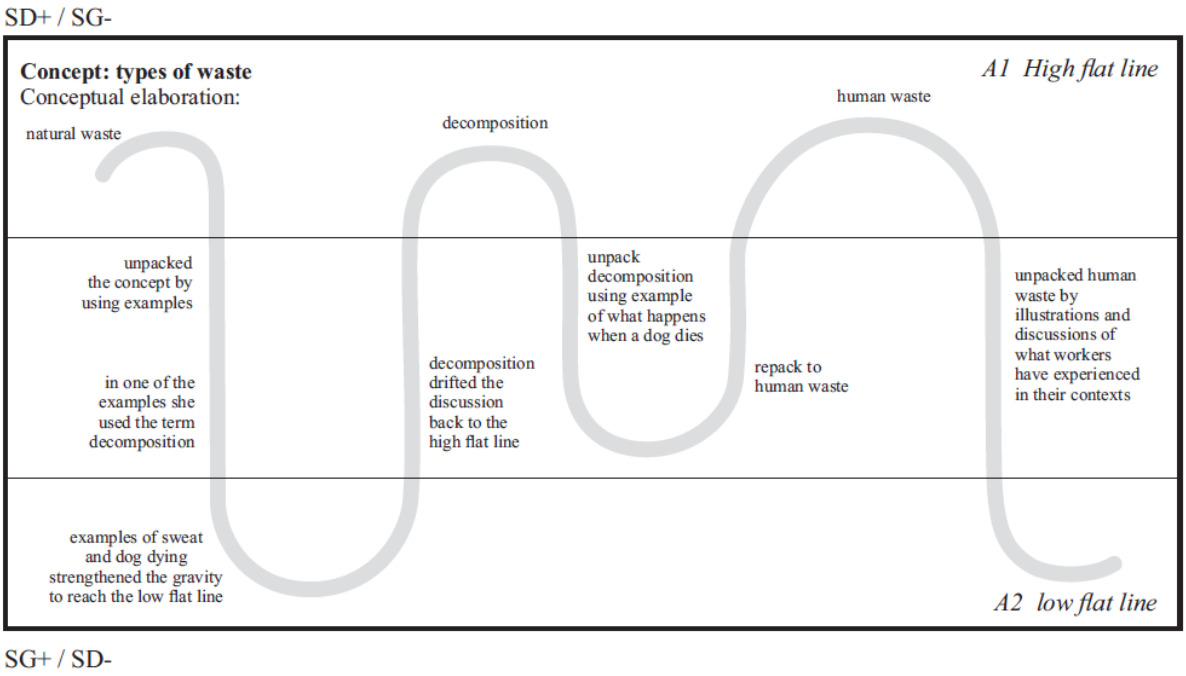


Figure 7.5: Semantic profile of the discussion on land pollution

The discussion of land pollution above shows a semantic profile with a repeating movement from the high flat line (SG-/SD+) to the low flat line (SG+/ SD-), showing a similar pedagogical practice pattern to the introduction of the concept of air pollution.

In this case, the facilitator introduced the concept 'land pollution' and explained it using another concept which was degradation. She realised that the concept degradation was foreign to the learners. By doing this, she thought she was strengthening the SG- and weakening the SD+ by using the concept degradation but had to go back to the upper flat line as this concept was also foreign to learners. She was then forced to explain the concept of degradation. She explained this using examples from the context of the learners (agriculture) and the impacts of pesticides used in this context. By using examples she moved down to the lower flat line with a high level of SG+ and a low SD-. This discussion, however, introduced another concept 'organic farming', which again learners did not understand. She then went into another SG+/SD- movement to mediate this concept by trying to explain it using examples, explaining it as another alternative that is utilised to substitute the use of chemicals, pesticides and insecticides. By introducing new concepts that were not known to the learners, the semantic wave is pushed back to the upper level of weaker SG- and SD+. Again the facilitator tried to strengthen the semantic gravity by defining the concept using simpler language. After the definition she strengthened the semantic gravity (SG+/SD-) by giving examples from the context "*If you are a stock farmer, one grows his stock without using genetically modified*

plants foods and medicines", and she applied this at the lower flat line to explain further "*the consequences of the use of genetic modified substances on health and the environment. The consequences are that they impact on our health".* This is on the flat line as this is what learners experience in their contexts and lives (i.e. health impacts from land pollution).

Example 3: Water pollution

As in the previous two examples, the facilitator commenced with defining the concept using the manual and then using examples to mediate understanding of the concept, which in turn introduces new concepts, as outlined in the data sequence and in Figure 7.6 below.

> ***Facilitator introduced the concept of water pollution by using an explanatory definition:*** *"It is caused by the introduction of chemical, physical or biological material into the water systems that degrade the quality of the water and have an effect on the organisms that live in it."*
>
> ***She used an example****: "For example when the animals are dead they are deposited by waters into the rivers."*
>
> ***This led to introduction of a new concept****: "They affect the ecosystem."*
>
> ***The facilitator then began to explain the new concept:*** *"The ecosystem is a community living organisms in the river."*
>
> ***She related this to a familiar example of learners' own experience:*** *"As we as people are having our communities."*
>
> ***She continued with contextual examples****: "The river community includes fishes, tadpoles and microbes. When a chemical is introduced into this community, it destroys and kills the members of the water community."*
>
> ***The facilitator then introduced new associated concepts****: "The examples of the water pollutants are dissolved or suspended solids, pesticides, heavy metals and non-biodegradable and bio-accumulative chemical compounds."*
>
> ***Facilitator asked a question:*** *"How do these things get to the water?"*
>
> ***Learner:*** *"They are washed by the rains into the water source."*

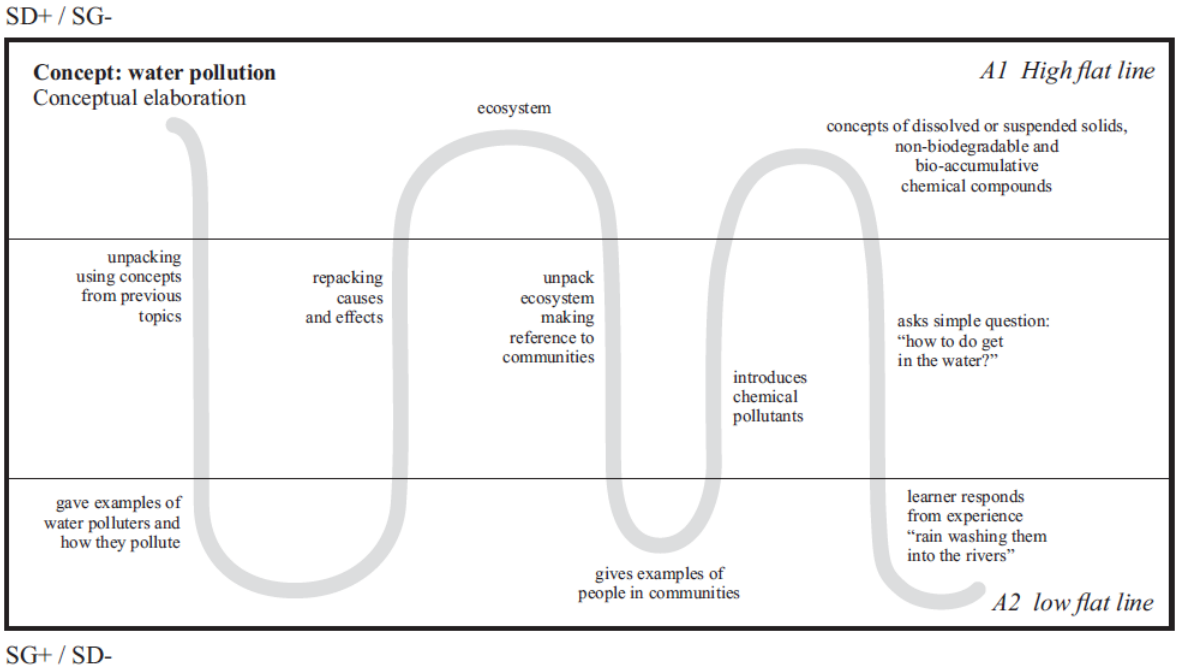


Figure 7.6: Semantic profile of discussion on water pollution

In this example, the facilitator commenced by explaining the causes of water pollution at the upper flat line (SG-/SD+). She used a number of high density terms or concepts (introduction *of chemical, physical or biological material into the water systems that degrade the quality of the water").* She unpacked this explanation down to the lower flat line (SG+/SD-) by using everyday examples of animals being deposited into waters when they are dead. From the lower flat line she moved up to the upper flat line as she explained the consequences of this and in the process introduced another high density concept, the 'ecosystem' (SG-/SD+). Realising that learners didn't know the concept, she then had to move down the wave – by explaining the concept of ecosystem using simpler language (via reference to communities, including an analogy to learners' own communities) (SG+/SD-). She stayed with the SG+/SD- level, holding the wave down at the lower flat line and returned to explaining river communities. However, the lesson did not end there; she repacked the discussion back to the upper flat line by introducing the effects of chemical materials in the water ecosystem and introduced a new set of densely packed concepts associated with types of chemical pollutants "e.g. non-biodegradable and bio-accumulative compounds" (SG-/SD+); these were not elaborated further, but the discussion shifted to how such pollutants get into the river. This was tackled with a simple question which learners can answer from their experience (SG+/SD); *this is the first time that learners responded*.

This semantic wave pedagogical pattern mirrored the semantic wave pattern used in the training so far (i.e. start with SG-/SD+, move to SG+/SD- and then up to SG-/SD+ again, and down to SG+/SD-), each time slowly elaborating aspects of the main concept with new concepts and examples.

This section of the lesson ended on the SG+/SD- (lower flat-line) level and the facilitator proceeded to the next discussion and sub-topic, which was categories and types of waste.

Example 4: Categories and types of waste

This section of the lesson differed from all of the above, as the facilitator started the lesson with reference to the contextual knowledge of the learners in a discussion on domestic waste as shown in the data extracts below and in the semantic profile shown in Figure 7.7 below.

> ***Facilitator asked a question**: "What waste do we produce at home?"*
>
> ***Learners responded**: "Egg shells, bread crumbs, peels of vegetables, food remnants."*
>
> ***Facilitator elaborated on learners' answers and introduced new concepts and asked another experiential question:** "All these are biodegradable, can you give other examples which are non-biodegradable?*
>
> ***Learners:** No response.*
>
> ***Facilitator:** "What do you use for cleaning?"*
>
> ***Learners responded**: "Plastics, soaps, polishes, and sprays."*
>
> ***Facilitator responded by elaborating on learners' responses**: "They also form domestic waste."*
>
> ***Facilitator then introduced a new concept of industrial waste:** "Industrial waste is waste produced by industries."*
>
> ***Facilitator then introduced another new concept of construction waste. She gave examples:** "concrete, cement, rubber and dynamite."*
>
> ***Facilitator then introduces another new concept describing different types of waste:** "Agricultural waste: pesticides, fertilisers. Mining waste: This waste produced by mining activities. Waste is harmful to the environment. Electronic waste: computers and cell phones."*

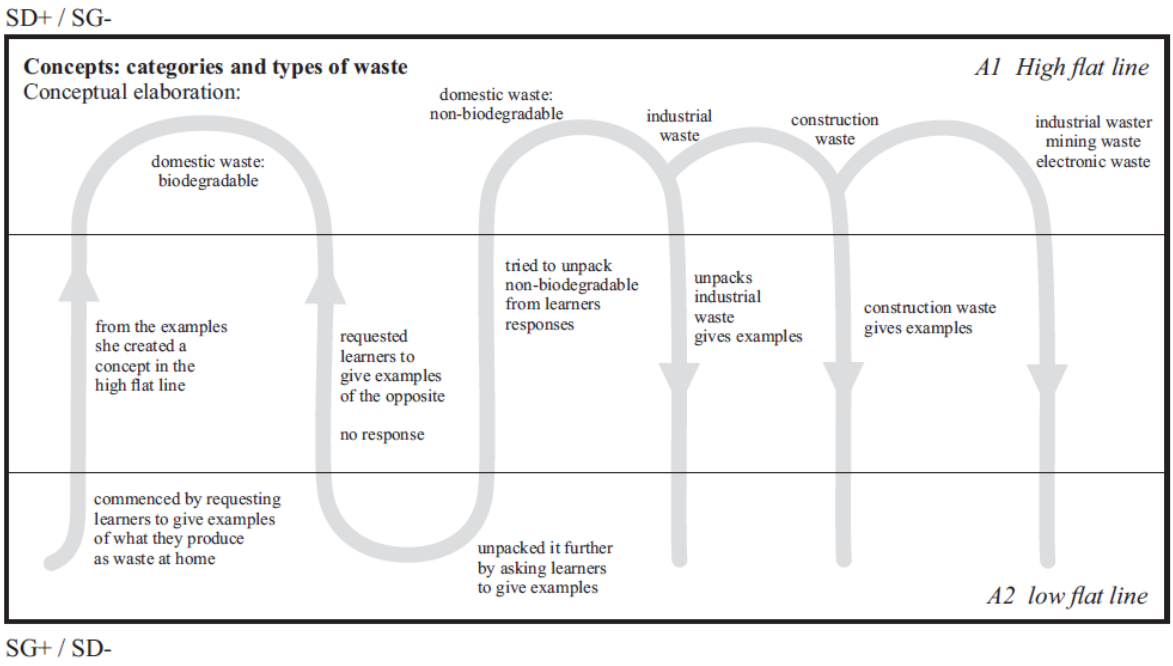


Figure 7.7: Semantic profile of the discussion on categories and types of waste

In the discussion on domestic waste, the facilitator commenced from the low flat line (SG+/SD-) when she asked learners to give examples of what they produce as waste at home. Learners responded. From this the facilitator built up the concept of *biodegradable domestic waste* moving to the high flat line (SG-/SD+) and then asked learners to give further examples of *non-biodegradable domestic waste* (i.e. the opposite concept), which the learners did (SG+/SD-), only after further elaboration related to a familiar concept, namely 'cleaning'. This helped the facilitator to develop the concept of non-biodegradable domestic waste at the high flat line (SG-/SD+). *Here it is noteworthy again that learners were responding to this sematic strategy.* From here, however, the facilitator appeared to give up on using learners' experience as the basis for building up concepts (i.e. a SG-/SD+ first strategy), and 'switched' to the direct opposite strategy using a SG+/SD- strategy for all the other concepts. She introduced the concept and gave examples, introduced another concept and gave examples, introduced another concept and gave examples. This produced a sequence of downward semantic shifts from condensed, decontextualised ideas (SG-/SD+) to simple concrete understandings (SG+/SD-) as shown in Figure 7.7, but the facilitator did not pause to see if learners were connecting with the concrete understandings that were being promoted via this strategy.

From here, the facilitator moved to the next discussion, which was on waste management systems in South Africa.

Example 5: Waste management systems in South Africa

This pedagogical sequence was centred on explicating the eight steps of waste management in South Africa (see Chapter 5 for an overview of the content of Provider 1's materials, which shows all eight steps). These include: waste avoidance; waste generation; separation at source; and recycling (these were the four that I observed being taught). The pedagogical process was illuminated via the discourse extracts and illustrated via the semantic patterns that characterised the explication of the first four of the eight steps as outlined below.

Step 1: Waste avoidance

Facilitator started by explicating the concept of waste avoidance: *"Trying to avoid waste is the first important step. It is critical for manufactures to avoid the waste."*

The facilitator then explained how critical waste avoidance is: *"Avoid creating waste – this needs a mind frame change to take place among individuals and organisations to embrace this."*

She went on to give examples of waste avoidance approaches: *"e.g having a shopping bag, joining a lift club."*

The facilitator then linked the concept of waste avoidance to the concept of the '4 Rs': *"This links us directly to the 4Rs. The 4Rs are :- Reduce, Reuse, Recycle, Recover."*

From here she explicated the concept of recycling by linking it to cleanliness: *"Recycle – this cannot be done on dirty things, if you recycle dirty things you get less money as they have to hire a person".*

The facilitator then consolidated the 4R concept using references to legislation: *"Government has made a way of promoting this through alignment with Department of Environmental Affairs and the National Waste Strategy. Waste can be reduced by: reducing what we consume, reusing items several times, recycling those things that cannot be used and recovering energy from waste that is burnt, or that rots."*

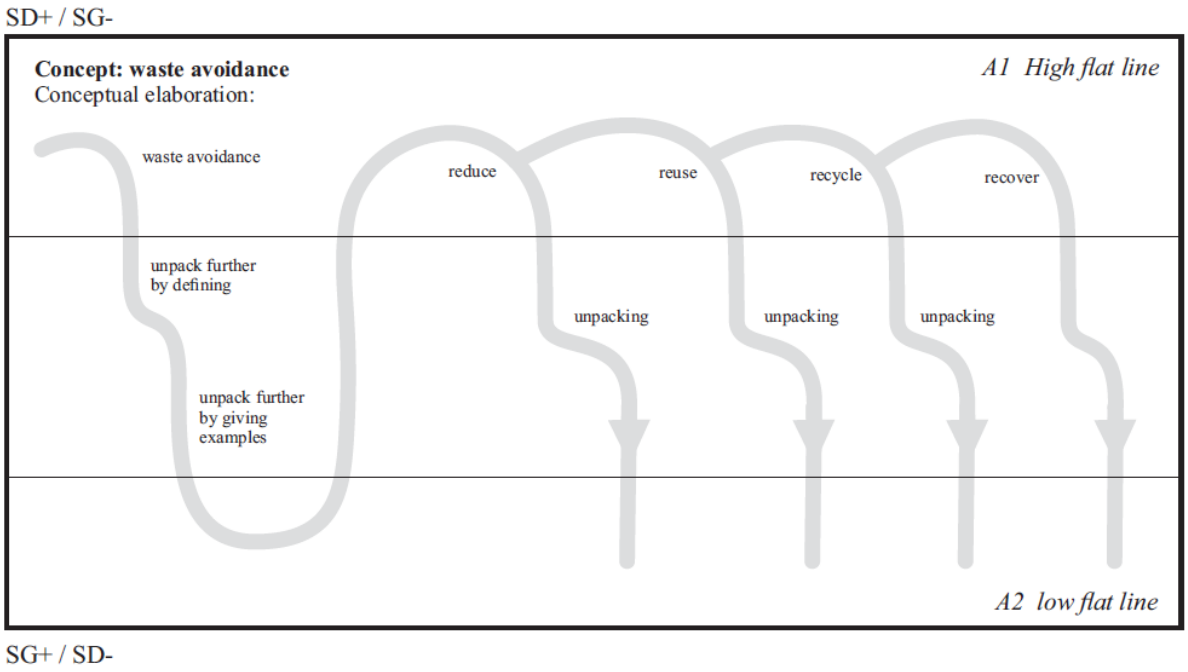


Figure 7.8: Semantic profile of the discussions on waste avoidance

As indicated above, the facilitator started by introducing the processes involved in waste management systems in South Africa, commencing with Step 1: Waste avoidance. She began by unpacking why the concept is important and for whom, at the upper flat line (SG-/SD+). From here, the semantic wave moved down to the lower flat line as she explained the avoidance by means of examples, *"having a shopping bag, joining a lift club"* (SG+/SD-). She then linked this concept to the concept of the '4 Rs' at the high flat line and she went on to explain each of the 4R's by explaining how each functions. Each explanation created a downward wave escalator from the high flat line to the lower flat line as each downward line commenced with a definition, which led to the lower level flat line where examples were given as illustrated in Figure 7.8.

Step 2 and Step 3: Waste Generation and Separation at Source

The facilitator connected waste generation to avoidance and explained that it was almost impossible to totally avoid waste generation. She starts with the concept of waste generation, and then uses examples to illustrate the concept further before introducing more concepts associated with waste generation, and then going further to introduce the concept of separation at source as shown by this data extract, and as illustrated in Figure 7.9.

> **Facilitator:** *"By buying groceries we bring home loads of packaging which we cannot use … Even with vegetables that we peel to consume, there will be waste generation no matter how conscientious we are."*

Facilitator: *"Following the next steps rigorously can reduce the amounts of waste sent to landfills by phenomenal amounts. (steps that can reduce amounts of waste sent to landfills)."*

Facilitator asked a question: *"Who generates waste?"*

Learners responded: *"Us, our homes and our households."*

Facilitator: *"We need to separate waste at home at our households."*

Facilitator explained the concept of 'source': *"Source can be the initial source of the waste. Examples of sources – It can be anything from the individual to a family, a housing complex, an office, a factory or even a bin of rubbish. It is the original point at which an accumulation of waste occurs."*

Facilitator asked a rhetorical question: *"What is meant by separating of waste? Separating at source is important as it simplifies the waste management system. It means a number of things namely: Division of waste into categories, with less time spent during sorting when all items are put together for sorting. Sort waste into what can be recycled and not be recycled."*

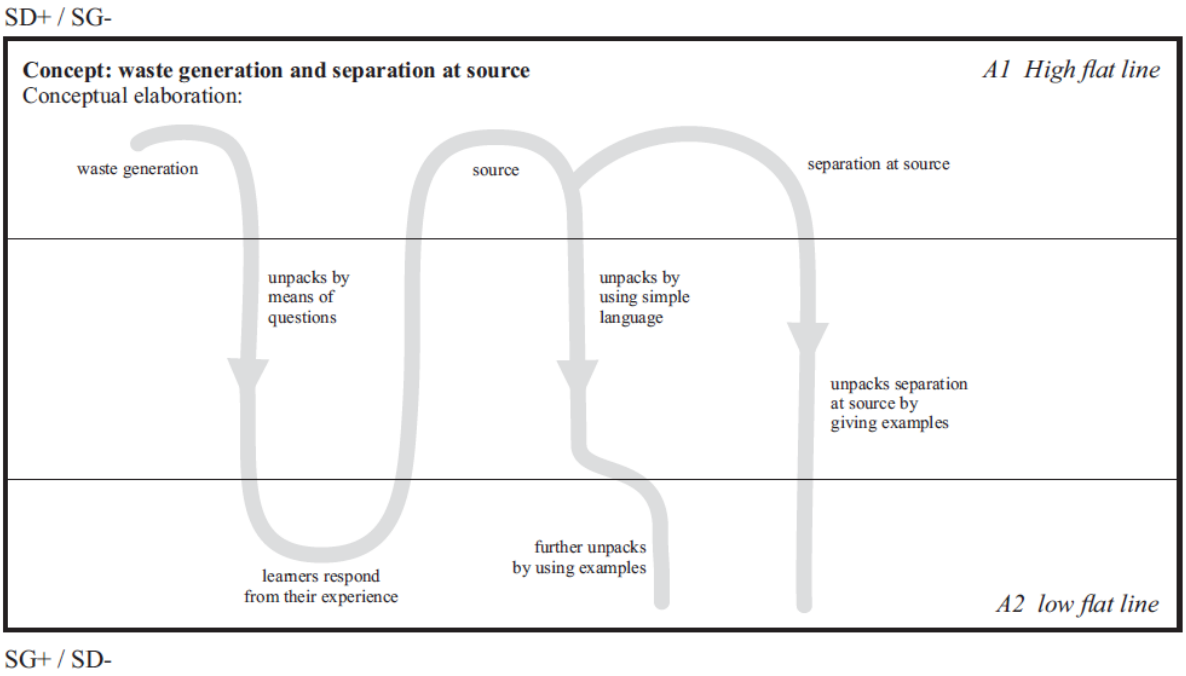


Figure 7.9: Semantic profile of the discussion on waste generation and separation at source

The discussion of the concept 'waste generation' created another downward escalator from the high flat line SG-/SD+ to the low flat line SD-/SG+, where she asked questions about who makes waste and learners responded from their experience. From the concept of waste generation, the facilitator introduced another concept, which was 'separation' at the high flat-line (SG-/SD+). She mentioned that if separation can be rigorously followed it can reduce the amounts of waste sent to landfills by a huge amount. She built this concept from their answers to her earlier question, when she commented that, "*if waste is generated at our households we also need to start separating waste from there*". She then went on to elaborate the concept of

'separation at source'. She gave a definition of a source using simpler language. "*It is the original point at which an accumulation of waste occurs*". She followed the definition and pushed the wave downward by giving different examples of the sources of waste relating these mainly to places where waste is generated and not to types of waste (e.g. plastic or organic sources of waste). She then gave a number of examples of what is meant by separating at source linking it to the next discussion, which was on recycling and was the last part of the lesson that I observed – the rest of the steps were to be covered in the next training session which I did not observe.

Figure 7.9 shows the predominant strategy of using high semantic density, but seeking to make this accessible through examples with lower semantic density. Only once did she 'build a new concept' from the knowledge and experience of the learners (i.e. from the position of lower semantic density to higher semantic density).

Step 4: Recycling

To mediate the concept of recycling, the facilitator started by giving a definition, after which she explicated the benefits of recycling and discussed responsibilities for recycling, as well as items that can and cannot be recycled as outlined in the data extracts below and as analysed from as a semantic density and gravity pattern in Figure 7.10 below.

> ***Facilitator started by giving a definition of recycling:*** *"It is the process whereby discarded products and materials are reclaimed or recovered, refined or processed and converted into new or different products."*
>
> ***She explained further:*** *"One needs to do something with waste which will add value to it ... It [recycling] needs both money and infrastructure support, especially in the early stages of the initiative [recycling initiative] for it to be successful and sustainable."*
>
> ***Facilitator then explicated the benefits of recycling as follows:*** *"It reduces the waste stream going to landfill sites, thus saving landfill airspace; it can create jobs; it helps to reduce pollution and conserve natural resources; it conserves energy and reduces manufacturing costs; it reduces litter; it can reduce informal salvaging from landfill sites.*
>
> ***After this the facilitator dealt with the topic 'Whose responsibility is to recycle' by making a statement:*** *"It is everybody's responsibility to avoid making waste."*
>
> ***Facilitator asked a question:*** *"How does one avoid making waste?"* ***She answered the question as follows****: "Examples of processes people need to do to avoid waste: reuse, recycle, and repair unwanted items before they are discarded as waste."* ***She then made another statement:*** *"In that way we won't use up the earth's natural resources"* ***and elaborated with examples of things that can become 'extinct'****: "oil, minerals and trees too."*
>
> ***She then introduceds a differentiation in the concept of recycling (i.e. what can and can't be recycled' via the topic:*** *'What can be recycled'* ***and gave examples of things that can be***

recycled: *"Common items which include paper, cardboard, cans, scrap metal, plastic, glass, tyres lubricating oils. Unusual items include motor vehicles, white goods e.g. old fridges and microwaves) electronic products, batteries, and construction and demolition materials."*

From here she continued with differentiation of the concept via the topic 'What cannot be recycled' and gave examples of things that cannot be recycled: *"Dirty recyclable materials, Laminates which are materials made up of mixed layers, car windscreens, materials that are uneconomical to recycle because of insufficient volumes or transport distances to markets, and hazardous waste."*

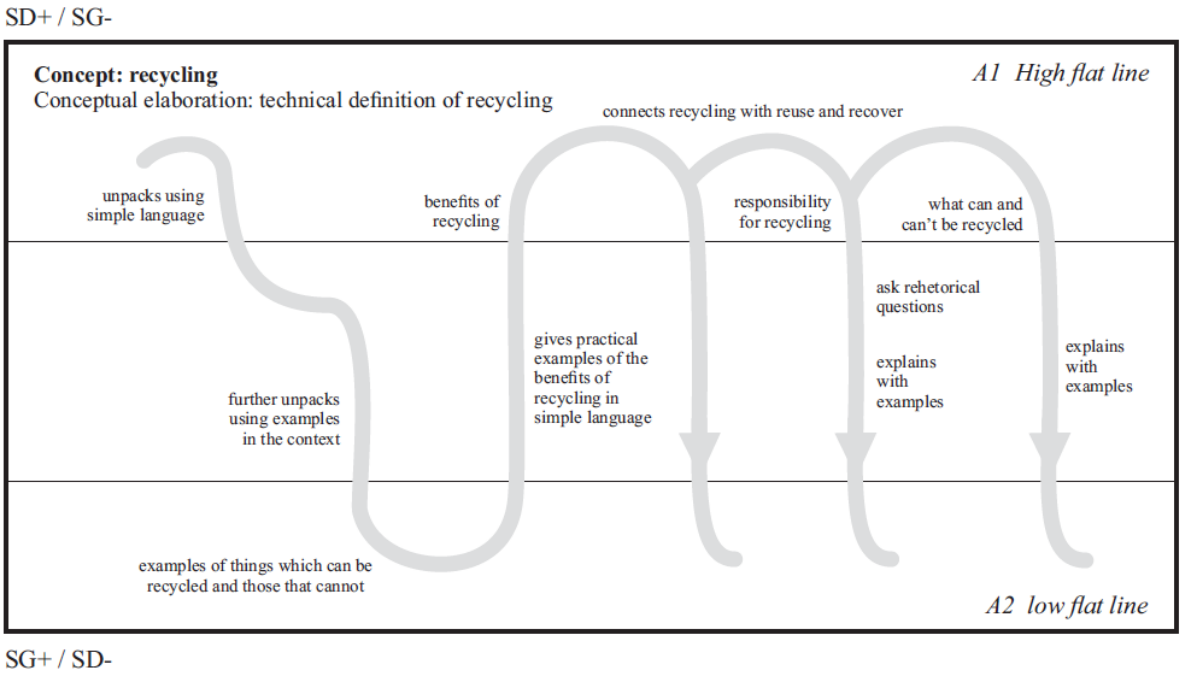


Figure 7.10: Semantic profile of the discussion on recycling

As indicated in the discourse above, the facilitator linked the previous discussion on separation at source with recycling. She introduced recycling as a concept at the high flat line using a technical definition (SG-/SD+), after which she tried to explain it using simpler language by noting that one needs to add value to waste. She then went on to discusses the benefits of recycling as a new concept at the high flat line. The facilitator asked a question about whose responsibility recycling is. She, however, answered the question herself and in this lesson used this strategy of rhetorical questions, which she then answered herself, a few times. The answers that she provided were more contextual, e.g. "*It is everybody's responsibility to avoid making waste."* She then introduced a differentiation between what can be recycled and what cannot be recycled, using examples. These semantic processes follow the same general pattern of introducing concept after concept (high semantic density) and making the concepts more accessible with examples that are closer to context (lower semantic density), thus the movement was primarily from the upper flat line to the lower flat line (SG-/SD+ to SG+/SD-).

The examples pushed the wave to the lower flat line, but as can be seen from the semantic profile, there was little building of concepts from the experience and knowledge of the participants (SD- to SD+); the pattern was to take concepts and then try to connect them to the experience and knowledge of participants (SD+ to SD-).

7.4.2.5 Discussion of the semantic profiles drawn from the observed classroom interactions in Provider 1's training programme

The introductory text in this section, together with Figure 7.1, introduced and explained how knowledge is transferred between and across contexts during teaching and learning. These transfers and circulation of knowledge are portrayed and displayed by means of waves which are also called shifts. Maton (2013, p. 8) asserted that the waves display the strengthening and the weakening of the semantic waves. He further explained that the analysis of shifts allows one to see the pedagogical process moves from abstraction to context and vice versa which, as noted above reflect higher or lower semantic gravity and semantic density. In Table 7.3 below, I provide a summary of the shifts that were reflected in the nine semantic waves (Figures 7.2 – 7.9) that showed nine detailed classroom interactions that I observed in the introduction to and in the teaching of Part of Unit 1 of Provider 1's training in the EPWP Waste Management Project at Level 2.

Table 7.3 : Summary of semantic waves representing the classroom interactions

Figure numbers	Downward escalators	Upward shifts	Dominant semantic pattern reflected
7.2	More emphasised	None	SG-/SD+ to SG+/SD-
7.3	More emphasised	Less emphasised	SG-/SD+ to SG+/SD-
7.4	More emphasised	Less emphasised	SG-/SD+ to SG+/SD-
7.5	More emphasised	Less emphasised	SG-/SD+ to SG+/SD-
7.6	More emphasised	Less emphasised	SG-/SD+ to SG+/SD-
7.7	More emphasised	The shift commenced from the context (lower flat line) upwards, but after that downward escalators were used again	SG+/SD- to SG-/SD+ (but only at the start of the session, thereafter the dominant pattern of SG-/SD+ to SG+/SD- was reflected)
7.8	More emphasised	Less emphasised	SG-/SD+ to SG+/SD-
7.9	More emphasised	Less emphasised	SG-/SD+ to SG+/SD-
7.10	More emphasised	Less emphasised	SG-/SD+ to SG+/SD-

The summary in Table 7.3 above indicates that most of the semantic waves move from the high flat line to the low flat line. Downward semantic shifts were therefore repeatedly produced from condensed, decontextualised ideas and concepts (SG-/SD+) towards more simple,

concrete and contextualised understandings (SG+/SD-). As can be seen in almost all of the semantic pattern analyses above, the facilitator repeatedly started with a condensed, decontextualised concept and then proceeded to unpack and exemplify the meanings. Only once did she start with the contextual understanding of the participants and only a few times did the downward movement fully connect with learners via getting concrete inputs and feedback from them. Most of the time the contextualisation was based on the facilitator's examples and experience and also assumptions of what would be meaningful to the learners.

Overall, the semantic profiles show little 'actual connection' or responses that actually show learners' experience and understanding in the training. This is shown by the dearth of learner responses to the many, often rhetorical, questions. The semantic profiles also show that downward escalators are more emphasised than the upward shifts. What are the implications of this? Downward escalators occur when abstract, specialised, academic knowledge is emphasised and therefore that abstract knowledge needs to be unpacked using everyday language and examples to reach the lower flat line to aid comprehension and 'connections' to learners' experience and practices.

As can be seen from the observations and the semantic wave descriptions in Figures 7.2-7.10, the facilitator spent most of the time introducing learners to new waste management concepts. She also spent time trying to make the concepts more accessible to the learners through a range of strategies such as using simple language and simpler definitions, using everyday language, stories, past experiences, pictures and practical and locally accessible examples to assist the workers to recall and match or connect their everyday experiences and past experiences with the new concepts. She also used questions, but much of the time these were rhetorical and she ended up answering them herself. She also, but only twice, built new concepts from the experience and existing knowledge of the learners as her starting point for the questions. In both cases, this appeared to be a productive approach as workers responded better to her inputs and appeared to be more engaged with the lesson.

As she engaged with process of unpacking of concepts, she realised that more foreign concepts were being introduced that learners did not understand, which kept on pushing the shift of the waves to the higher flat line again for further unpacking. This process highlights the way that introduction of a key concept requires conceptual elaboration, which in turn requires contextualisation, which was indicated in all of semantic profiles. In the process, knowledge circulates and accumulates, although it was not clear from the sessions how much the learners

were actually grasping via this approach (the dominant SG-/SD+ to SG+/SD- approach) through which the learning of a sequence of concepts (with associated conceptual elaborations) was being prioritised and legitimated through the pedagogical practice. In the two instances where the starting point was more strongly on the SG+/SD- to SG-/SD+ pattern, there was more response and contributions from the learners, indicating that this strategy might be a better one to engage the learners in concept formation processes (see Chapter 8 where I reflect further on this).

According to Maton (2013), when teaching prioritises semantic density (the SG+/SD- to SG-/SD+ pattern) and leans towards stronger semantic gravity that is towards the contextualisation of concepts, the contextual accumulation of knowledge is compromised, while the conceptual accumulation of knowledge is privileged. As can be seen from the profiles above, the training clearly privileges conceptual accumulation of knowledge over contextual accumulation of knowledge, reflecting the strong ER+ / SR- epistemic specialisation code identified earlier in the construction of waste management knowledge and in the official and pedagogical recontextualisation fields. In interpreting this, the most important issue to consider is the purpose of the exercise. The purpose of this training is to enable the workers to be able to apply these concepts in practice in their contexts (the EPWP project context and more widely in their community and life contexts), which makes both the strengthening and the weakening of the semantic gravity useful, significant and substantial for the accumulation of waste management knowledge at Level 2. However, as noted above, it was not easy to understand the extent to which learners were actually acquiring the concepts via the pedagogical approach, as the conceptual engagement during the teaching sessions tended to be more facilitator dominated as can be seen from the semantic wave patterns illustrated in Figures 7.2-7.10. Therefore I decided to also analyse some of the assessment activities to see how this pattern influenced learners' engagement with the concepts.

7.5 CLASSROOM ASSESSMENTS OBSERVED

7.5.1 Evaluation and Exercises

After discussing the concepts within each part of the unit, the learners were divided into groups and given exercises. The facilitator then instructed the learners to turn to their formative assessments books and to discuss the exercises. The groups were later called upon to report to the whole class. The whole group went to the front. One would read the report through. They used a mixture of English and their mother tongue. After reporting they would be asked

questions on their presentations. Every member of the group was expected to answer questions directed to the group by other members of the class. Only two exercises and reports from exercises are discussed in this section to limit the scope and the length of the discussion. These are typical of the rest of the process and were therefore deemed adequate to illuminate the pedagogical process patterns and the specialisation and semantic codes that were being privileged, in order to identify the legitimation principles.

Exercise 1: Three types of pollution

The instructions as given to the groups by the facilitator are listed below:

> ***Facilitator:*** *"Now it is time for group work. Turn to page 37 of your formative assessment book. Question:* ***Discuss the 3 types of pollution. Bring up your own examples of pollution from your communities. Do not use the ones I have discussed with you and the one in the learner's guide.*** *Write your deliberation on the sheet of paper. Each group must nominate a person to come and report in front."*

The facilitator distributed sheets of paper and koki pens. The learners worked by themselves in the groups and then reported back as outlined above. Table 7.4 shows the report back from the groups on Exercise 1.

Table 7.4: Reports presented from the groups for Exercise 1

Group 1 Activities performed which impact on the environment	**Group 2** Activities performed which impact on the environment
Air Pollution: In our group we looked at examples in our communities: The people put their waste in dustbins. When they are full we take them out and burn the waste. The smoke comes out and spoils the air. Digging of the soil using machinery. Roadworks, power station and digging of crushed stone for construction. Veld burning contributes to smoke /smog in the air. Dead animals pollute the atmosphere with bad odours.	In our area the landfill/ dumping site is situated not far from the Black residential area. There are few recyclers and they recycle only cardboard and bottles. Other recyclables are not recycled, they are burnt. The smoke comes out and disturbs the nearby areas. A smog develops and is detrimental to the environment and the nearby schools and residential areas. Effluent from factories. Tyres – small businesses next to the road burn their tyres and this spoils the air. Veld burning affects the air. We lose our animals because of choking.
Land Pollution Mineral exploitation: they dig and spoil the land Crushed stone, toilets and Eskom poles. Degrade the soil by causing dongas and soil erosion. Manual digging and utilisation of homemade sewage systems as the people do not have	**Land Pollution** Waste spoils the land. It becomes a 'dumping site'. Moisture and water make the place unusable. Children develop rashes and sores. Big trucks carrying hazardous materials are involved in accidents. The oils spoil the grass and

machinery. Their activities spoil both the land and the air.	the road. The spills burn the grass while the spills cause more accidents.
Water pollution Swimming, drinking and doing of washing in the same river. Dead animals are washed by rain water into the river systems. The ecosystems are destroyed – animals, and microbes. Cars are washed in the same river – their oil spills spoil the water.	**Water pollution** Litter flows to the rivers and spoils the water. Chemicals used by people in gardens – they utilise them to increase their produce for commercial purposes but they are detrimental to their health. After the rains/ during the rainy season, the water deposits/ washes away the chemicals in the fields into the river systems. Ecosystems are spoilt by the chemicals. On the flat lands, the run-off creates furrows that lead to the rivers and end up polluting the ecosystem.

Table 7.4 mainly shows a similar view of, or interpretation of waste management as was shown in the workers' life experiences of waste management reported in Chapter 6. There was not much correlation between the answers and the detail of the concepts or examples as reported on above in section 7.4. In one or two cases, examples were similar to those used by the facilitator (e.g. the decomposing dead animals). This shows that learners primarily drew on their prior knowledge and experience of waste management, and less on what was introduced or discussed in the lessons as they applied the knowledge to context (SR+ / ER- / SD- / SG+) reflecting a strong social relation (SR+) and strong semantic gravity (SG+), and weak epistemic relation (ER-) and weak semantic density (SR-).

Exercise 2: Recycling in your own home

Facilitator question: *After these lessons, what will you do to recycle at home?*

The responses from the students are included below:

- ***Student 1:*** *I will attend funerals. Request people to clean the bottles of mayonnaise. I will collect them and use them for covering the electricity bulbs [re-use].*
- ***Student 2:*** *I will collect the mayonnaise bottles and use them as containers for sugar, tea and coffee [re-use].*
- ***Student 3:*** *I will collect old tyres and make shoes out of them [re-use].*
- ***Student 4****: Instead of pampers [disposable diapers] I shall buy nappies. We shall wash them as pampers are producing a lot of unrecyclable waste [avoidance].*
- ***Student 5:*** *I shall recycle and organise by myself the transportation of recyclables to the recycling company. Last year I had a very bad experience. I collected all the steel utensils in my yard. They were inclusive of the Singer sewing machine, my husband's old car engine. The lorries collecting recyclables passed buy my home. For all the recyclables mentioned above they gave me a lousy R5 [recycling].*

As can be seen from the above, the majority of the responses were focussed on re-use and avoidance, not recycling. Only one response focussed on improving recycling practice. The example reflects a similar pattern to the above: Learners drew on their prior knowledge and experience of waste management, and less on what was introduced or discussed in the lessons as they applied the knowledge to context (SR+ / ER- / SD- / SG+) reflecting a strong social relation (SR+) and strong semantic gravity (SG+) and weak epistemic relation (ER-) and weak semantic density (SR-).

7.5.2 Interpretation and Discussion of the Assessment Exercises

While the lessons emphasised a strong epistemic relation (ER+) and weak social relation social relation (SR-) as reflected in section 7.4 above, via explicit mediation of specialised knowledge in the form of concepts, definitions and conceptual elaborations (albeit using examples) using a general pattern and dominance of strong semantic density (SD+) and weak semantic gravity (SG-) in the pedagogical practice, the assessments and exercises reflected the opposite pattern, which was SR+ / ER- / SD- / SG+. This reflects a strong social relation (SR+) and strong semantic gravity (SG+), weak epistemic relation (ER-) and weak semantic density (SR-).

As explained above, in the evaluation and exercises, the facilitator gave instructions on how the exercises should to be conducted; namely to explicitly draw on their own experience and knowledge; and as can be seen from Exercise 1 and 2 above, the learners acted as per the facilitators' instruction. By doing this, the facilitator made the evaluation criteria explicit to the students which illustrates that the framing of the assessment (F+) was strong as the facilitator provided all the regulations with regard to assessments. The framing was, however, focussed on strong semantic gravity (SG+) and weak semantic density (SD-) and on a strong social relation (SR+) and weak epistemic relation (ER-), despite the pedagogical practice of the facilitator reflecting the opposite pattern in the lessons.

In the exercises, the learners were discouraged from reproducing the concepts and procedures as given and described by the facilitator in class. They were encouraged to come up with their own examples relevant in their own communities. There were no standardised answers expected. Evaluation was therefore less about the acquisition of new conceptual knowledge and differentiated conceptual elaborations presented in the lessons as mediated in the lesson, but more about understanding of the basic concepts in one's own experience and in community context. It was not about high marks or correct answers but about the ability of the students to apply the most basic level of the concepts by relating these (e.g. land pollution, water pollution,

air pollution, recycling) directly to their prior experience and life in their communities. Thus, the assessments were less about applying new knowledge and more about eliciting what learners already knew about the concepts; in other words they were more diagnostic of prior knowledge than application of what had been taught in the lessons. According to Maton's specialisation dimension, the social relations were emphasised in assessments more than the epistemic relations, reflecting very weak (ER-) and very strong social relations (SR+). This was coupled with very weak semantic density (SD-) and very strong semantic gravity (SG+). While these were contextualised, which is a potentially important dimension of applied learning as required for waste management, it was not the new or elaborated concepts that were contextualised, rather the exercises reflected more of a *prior knowledge diagnostic assessment*, which could have been more useful *before* the lessons, rather than after them, especially if the facilitator could have used these *to build the new concepts* as reflected in one or two instances in her practice above.

7.6 CIRCULATION OF KNOWLEDGE IN WORKPLACES

In this section, I consider the circulation of knowledge further by looking more closely at the link between training interactions and workplace learning interactions. This involved observations of formal training activities where the circulation of knowledge was documented in detail (reported on in detail in sections 7.2-7.4 above) and discussed in interviews with workers in workplaces (reported on in this section). The interviews in workplaces provided a window into some of the informal learning which took place in the projects parallel to and following the training. The workers were interviewed to establish learning that had taken place in the project with an emphasis on what the individuals learned and how they used that knowledge. As mentioned in Chapter 3, the workers were interviewed after seven months of participation in the project.

When I got to the project after seven months, three of the six workers interviewed previously in Project 1 had left the project. The project manager suggested that I interview another three workers who had been part of the project since at the beginning. I did not repeat the Phase 1 interviews with them, but only used the post-seven month interview schedule with them. The results of the interviews are included in the discussion below.

7.6.1 Knowledge Acquired after Seven Months of Participation in the Project

Cawekazi (see section 6.3.2.1) was interviewed after seven months of working in the project. She was requested to share what she has learnt about the cleaning and management of waste during her participation in the project.

> After seven months it emerged that Cawekazi's learning had taken place at the landfill site. At the landfill site she met people that were "*separating the waste, cardboard, glass bottles, plastic bottles … They came with trucks which come to collect the separated waste which were written 'Chola Konke' (pick up everything).''* She observed the activities of these people. She learned from the people in the landfill that waste can be: "*collected, sorted, reused, and recycled … Waste can be collected, sold and recycled*". This she learned by observing people doing things. She also realised that this practice of recycling brings an improvement in the lives of the people.
>
> Cawekazi also learned about people's attitudes and behaviours towards waste. She learnt that "*people have different behaviours and temperaments. Some clean and others do not. Some put the waste where it is supposed to be put in cages while others throw it outside the cage.''* She realised that the status of waste and waste management is influenced by the attitudes of people. They do not act according to the ways they are expected to behave even if they are told and taught. That is clarified by the state in which they find the town when they have been away on holiday. She said, *''When we go away during weekends and holidays we find the town filthier''.* She suggested that the business people in town need to be taught on how to manage their waste.

Love (see section 6.3.2.3) was also interviewed after seven months of working in the project and was requested to reflect on what he had learned during the project.

> Love indicated that he had learned that "*... waste need not be burnt amongst or in the vicinity of the people. Waste needs to be collected, put in plastics, and sent to the tip [landfill].''* This statement depicts that to him it is not wrong to burn waste, the only problem is burning the waste in the vicinity of the people.
>
> Love has learnt how to manage the soil and prevent soil erosion. He mentioned that he prevented soil erosion by planting grass and trees. This was learned from the practice of doing this. He also learnt from people working at the landfill how waste is separated in the landfill site. Here he learned correct ways of sorting waste. He learned that *''In the sorting it should be bottles only and plastics and plastic containers alone''*. He learned that some of the waste can be reused, sold and recycled.
>
> Love learned further about the attitudes and behaviours of people and how they can impact on waste activities. "*In town there are cages and bins but people do not throw in bins and cages … When the project workers are not around during weekends and holidays the town becomes more filthy.''* Their observation of other agents in the project has exposed Love to acceptable ways of doing things. He learned that people can make money out of the reuse and the recycling of waste. To curb waste, he proposed the

creation of awareness programmes for businesses and all other stakeholders in town on how they need to deal with waste.

Sindi (see section 6.3.2.6) was interviewed after seven months of working in the project. Similar to the others, she shared what she had learned:

> Sindi indicated that she had learned that "*waste needs to be separated into cardboard, paper, tins and bottles. Why? They can be used again. They can do another work … Waste can be used in a lot of other projects. It can be recycled..*"
>
> She reported that she has realised that "*the people do not listen, they throw waste wherever they like, despite the effort by workers to make them aware"*. She suggested that there should be security guards in town to report incidences of people littering to the police (i.e. law enforcement).

In the second interview, Luma (see section 6.3.2.2), Happy (see section 6.3.2.4) and Andisiwe (see section 6.3.2.5) had left the project; consequently the project implementer suggested that I see if I could interview the following in their place: Siphokazi, Zuko and Nompakamo as they had been participating in the project since the beginning of the project. Their responses are discussed below.

Substitute 1: *Siphokazi* is a female worker who has been in the project for seven months. She reflected on what she has been learning in the project.

> Siphokazi claimed that she has learned that waste should be removed from lying around homes and amongst people as it causes diseases and the fact that cleanliness brings good health.
>
> Siphokazi learned how to clean the dumps, how trees and grass should be planted to prevent soil erosion. She learned that at the landfill site there are people who separate the paper, cardboard and bottles, both plastic and glass bottles. Tins are also separated. She also learned that people in town throw paper on the floor even when there are facilities for them to put them in e.g bins and cages, reflecting poor attitudes to waste management.

Substitute 2: *Zuko* is a male worker who has been in the project since the beginning and he also shared what he had learned.

> Zuko learnt that waste can be used again e.g plastic containers. He learned that *"as people we need not burn the waste as the smoke causes the pollution of the air. Polluted air has effects on climate change because of that we do not get rain there is drought (concept of climate change)."* He also learnt that waste can benefit the people, it can act as a resource.

Zuko learnt how waste can benefit the people. He observed a group of people working at the landfill. He learnt how they separate the plastics. From the sorted and separated plastics they develop different artefacts such as waste mats and clothes. He said, "*We develop other glass out of glass. Tins are recycled. Bottles can be used to produce other bottles while tins can be used to produce other tins."*

He also learned about people's attitudes. He commented, "*Just on the Easter weekend that we have not been working we found the state of the town back to where it was before the project commenced. The people had created illegal dumps. They have thrown next to bins instead of throwing in bins*." He commented that the people, inclusive of business people and hawkers, need to be taught door to door how to manage the waste.

Substitute 3: *Nompakamo* is a female worker who has been in the project since the beginning and she also shared the following:

Nompakamo learnt that there are things that should not to be done. "*We need not burn waste. We need to collect it, put it into plastics, into cages and then put it into trucks and send to landfill sites."*

7.6.2 Knowledge Acquired after Seven Months of Participation in Project 2

After seven months all six workers interviewed previously in Project 2 were still working in the project. They had been in the project from the beginning. The results of the interviews are included in the discussion below.

Abongi (see section 6.3.5.1) was interviewed after seven months of working in the project. She was requested to share what she had learnt about the cleaning and management of waste during her participation in the project.

Abongi learnt the importance of planting trees in an environment. "*We learned that after cleaning and removing the grass, we need not throw the grass away. We need to remove the grass and put it back in the soil. It will decompose and create manure."*

Abongi also learnt how to use different environmental resources in the development of a park, for example, the stones, and the different types of grass found out there. They were also taught how to prepare the soil.

Khaya's (see section 6.3.5.2) feedback can be summarised as follows:

Khaya learnt why it is important to manage waste in town and ways of managing it and the fact that persons need not throw waste anywhere. He commented that when dealing with waste the people and the environment should be taken into consideration. He also learnt that it is not good to burn waste as the smoke is dangerous to the people. He also learnt that one can create a business out of waste. One can collect the bottles and the tins and sell them.

Lizo (see section 6.3.5.3), during the seven months of working in the project, participated in the creation of a park which is one of the strategies used by municipalities to remove illegal dumps and substitute them with user friendly activities which benefit societies.

> Lizo commented that both people and environment should be taken into consideration in the management of waste. It should not be burned as this has effects on both the people and the environment. People can also create businesses out of waste.
>
> Lizo also learnt about different types of soils and the different names of plants. And he learned how to develop a recreational park from start to finish. They prepared the soil, removed the waste, dug and planted vegetation. They also made footpaths and replanted the grass in the park.

Mfana (see section 6.3.5.4), after seven months of working in the project, shared the following:

> Mfana learnt that there are useful things that we can utilise in waste. *"We can collect bottles and tins and recycle them. Bottles can be used to produce other bottles while tins can be used to produce other tins. We can do that as groups or I can do it alone.*"
>
> He learned that they can separate waste and prepare it for recycling and that people in town are not using the facilities like bins. They throw waste next to them instead of throwing it in bins. He recommended that the municipalities need to create awareness amongst the businesses in town on how they need to deal with waste.

Sanda (see section 6.3.5.5) shared the following:

> Sanda learnt the importance of planting trees in an environment. "*We plant trees and sheer the grass. We make compost. We need not throw the grass away. We replant it back in the park."*
>
> Sanda also learnt how to make compost: "*We dig put in the grass and cover it with soil and plant over it."* She learned how to use manure when they planted trees. Additionally, she learned processes of the waste hierarchy, for example "*we collected the waste and put it in plastics. We do not mix grass and tins. We keep some of the tins and use them for drinking water."*

Bongi (see section 6.3.5.6**)** learned that they should not burn the waste as the burning contaminates the air. *"We need to separate the waste and need facilities to measure and recycle the waste."*

> Bongi also participated in the development of the park: He learnt that *"...we can use the ordinary, natural resources for beautification and therefore need not buy everything, but can take what is available for example stones, different types of grass,*

aloes to beautify and different types of indigenous trees." He learnt that trees can bring different types of birds into town.

Bongi also learned that they could collect the decomposed materials within the area and use them as manure and also develop our own composting facilities. He said: *"We can create cooperatives or businesses which can assist to keep and maintain these facilities moving forward."*

He learned how to manage the waste and dispose it. They need to *"... pick, sort, put it in black bags and put it together for the truck to come and collect*".

7.6.3 Synthesis of the Findings on Learning after Seven Months in the Project

The evidence emanating from the home, school and the project at the beginning of the project illustrates that the workers were not informed or clear about the scientific knowledge and processes in waste management at home or school (see section 6.3). At the beginning of the project they did not have knowledge of the processes of the waste hierarchy. They were ignorant of the fact that disposal in the landfill site should be the last resort. They had an understanding of everyday knowledge which says that waste should be burnt.

As shown in the citations above from all the workers interviewed, during their six months of participation in the project, through interaction with other stakeholders and from their experience of the training, their scholarly scientific waste management knowledge was strengthened. They learned mainly by observing how other stakeholders function and deal with waste e.g. in the landfill site and through practice. They realised that some processes work while others do not. They were exposed to scientific and scholarly knowledge performed by other stakeholders in the field. They learnt that improvisation is sometimes key in the management of waste; it does not depend on bought equipment always. They learnt that waste is a resource they can utilise and that it is possible to create businesses out of waste as individuals or as a groups. They also realised the impact of people's attitudes on waste management practices. They learnt that though people are taught and told how to deal with waste, they do not necessarily heed the messages and rather do as they like, thus creating environments with illegal dumps. This provided impetus for them to recommend ongoing education, training and awareness programmes for business people and the community.

In particular, it seemed that they had learned from two key practices especially, namely participating in waste management activities in the landfill site and from the composting activity. Several workers noted that they had learned from the people in the landfill site that

waste can be: "*collected, sorted, reused, sold and recycled."* They also realised that this practice of recycling can bring an improvement in the lives of the people. They learned that as people we need not burn waste as smoke causes pollution of the air. *"Polluted air has effects on climate change because of that we do not get rain there is drought (concept of climate change)."* Lastly, they learnt that waste can benefit the people; it can act as a resource. And in realising this knowledge practically through an applied activity, they learnt how to make compost: *"We dig, put in the grass and cover it with soil and plant over it. We use manure when we plant trees."* This shows that more complex knowledge can be mediated via engagement in practical or applied activities that can also expand in complexity i.e. from burning waste at home and school (prior to the project), to putting waste into cages (at the start of the project); to sorting and managing waste in a landfill (further on in the project), to making use of waste for economic activity via the composting activity (further on in the project). In these activities increasingly complex concepts were being mediated (ER+ / SD+) but through applied contexts where SR+ were also recognised.

During the seven months of participation in the projects, two codes of knowledge emerged from their activities, namely the knowledge code (ER+) and the social code (SR). The knowledge code (ER+) is demonstrated via the waste management knowledge acquired through participation which emphasised waste management specialist knowledge, waste management processes, procedures and skills which showed that the knowledge was oriented towards the object of waste management, continuing the emphasis on a strong knowledge code (ER+). At the same time, however, part of the waste management knowledge that was emphasised places emphasis on attitudes and behaviours of people and the social setting, as was indicated by all of the workers having learned about people's attitudes to waste management and their recommendations for local awareness raising activities for business and communities (SR+). This shows a strengthening of the social relation code (SR+) in relation to the strong knowledge code (ER+), reducing the initially strong 'code clash'. Maton (2010; 2014) argued that all the fields have both knowledge and social codes but one may be stronger (ER+ /SR-) than the other while the other is downplayed or weaker and vice versa (SR+/ER-). As noted above, the waste management training via both on-course activities and in-field learning emphasised the ER+ code, but made use of the SR+ code to strengthen learning, although ER+ remained dominant. Of particular interest from the reflections on this section, especially workers' reflections on what they had learned, was the insight that they had learned

increasingly sophisticated knowledge from experience and practices in the project. This will be reflected on in more depth in the next chapter.

7.7 CONCLUSION

In this chapter the reproduction and circulation of knowledge in waste management were analysed as found in the pedagogical practices of Provider 1 and in the workers learning experiences seven months after joining the project. Observations of formal training activities and interviews of workers in workplaces were conducted. The training activities signify the formal part while interviews in workplaces represent the informal part of learning. The chapter revealed a code clash between the framing and pedagogical practices (ER+) and workers' knowledge and experience (SR+), but showed how various activities, especially work-based experiential learning, was able to reduce the code clash and support expansion of workers' scientific and propositional knowledge. The pedagogical practices in the formal training tended to show a pattern of descending from high levels of semantic density (SD+) to lower levels of semantic density (SD-), with corresponding low levels of semantic gravity (SG-) to high levels of semantic gravity (SG+) reproducing a descending pattern of SD+/SG- to SG+/SD- in repeated descending waves with few ascending waves from SD-/SG+ to SD+/SG-. This showed poor management of the semantic gravity wave in the pedagogical practices of Provider 1. This will be discussed in further detail in Chapter 8, where the study will also be summarised and recommendations will be made.

Chapter 8:

Synthesis of the Study Findings and Recommendations for Improving Training and the Circulation of Knowledge in the Level 2 EPWP Working on Waste programmes

8.1 INTRODUCTION

As indicated in Chapter 1, the context of the study is constituted by the Working on Waste Expanded Public Works Programme projects funded by the Department of Environmental Affairs in South Africa. This programme creates jobs for the unemployed and supports workers to gain skills while they work to increase their capacity to earn an income (South Africa. 2003). They undergo training while working in the project. It is envisaged through its policies that participating in the activities and the training activities of the projects will improve the present and the future status of knowledge and status of the workers and the environment in which it is implemented. Motivation for this study was provided by the realisation that sometimes at the end of the project, the state of affairs returns to how it was before the project commenced. The study focused on waste management projects with less infrastructure, which are inclusive of street cleaning and beautification projects in rural towns.

Since waste management, especially in the area of worker training, is quite a new field of study in South Africa, this study commenced by investigating the nature and the structure of knowledge and its underpinning structuring principles at the level of production (waste management knowledge in particular) within the field. The aim of the research was to investigate legitimate knowledge developed by producers in the waste management field of production, its recontextualisation in Waste Management training manuals and documents and how it is reproduced in the EPWP waste management pedagogic practices inclusive of workplaces and associated training activities at Level 2 of the NQF as conducted in the projects. The circulation and reproduction of knowledge was investigated by looking at the pedagogy and workplace learning interactions, the underlying principles structuring this knowledge and practices, as well as the dispositions of the workers (the experiences they bring to the project) as these relate to how knowledge circulates. It was envisaged that the investigation would identify the weakest links, matches and clashes, which would lead to identifying problems.

A case study approach was adopted to capture the complexity of the participants' experiences. Two EPWP projects were selected as cases and participants in the study were sampled from the two projects. The study's data is comprised from documents, questionnaires with government officials working in the field and interviews with workers in the EPWP projects. The details of the participants are tabled in Chapter 3. The thesis drew upon three theories to analyse the documents, students' prior waste management experiences, recontextualisation of knowledge in documents and observation of the teaching practices and workplaces. These theories were Bernstein's theory of educational knowledge, knowledge structure, knowledge codes and the pedagogic device (1977, 1990, 2000); social realism emanating from critical realism; and Maton's Legitimation Code Theory (Maton, 2000, 2007, 2009; Moore & Maton, 2001). Two dimensions of Maton's Legitimate Code Theory, namely "specialisation" and "semantics" were utilised in this study.

The purpose of the present chapter is to discuss the key findings of the study in light of these theoretical perspectives. Each discussion of the findings encompasses the question, the data used to answer the question, the clarity on what is emphasised, the key findings and their discussion, the conclusions and implications. Each section closes with a discussion synthesising findings in terms of Bernstein's structures of knowledge and Maton's legitimation codes of specialisation/semantics.

The findings from the study are summarised and discussed in relation to the following questions:

Research questions:

- What is the structure of legitimate knowledge and the knower in waste management?
- What are the underlying principles underpinning knowledge and the knowers in waste management?
- How is the knowledge from the level of production into waste management training qualifications, documents and manuals for worker training on the NQF Level 2?
- How is the knowledge reproduced and evaluated in the waste management Expanded Public Works training activities (formal) and workplaces (informal)?
- How does waste management knowledge circulate amongst the workers in the training activities and workplaces?

8.2 FINDINGS AND DISCUSSION

The main findings from the study are summarised and discussed below using a series of Analytical Statements:

8.2.1 Analytical Statement 1:

The structure of waste management knowledge at the level of production is hierarchical, inter- and multidisciplinary and takes the form of a 'region' which emphasises *applied disciplinary knowledge*

The field of production according to the pedagogic device is the level where new knowledge is constructed. It represents the intellectual field of the system, where individual researchers and research groups at various universities and research institutions produce new ideas, theories and specialised discourses. Texts produced by this intellectual field include academic articles and reference books (Bernstein, 1990, p. 206; Maton, 2013, p. 47). The findings under this heading explains the structure, the nature and different ways in which what is considered legitimate knowledge is realised within the field of waste management at the level of production.

Social realists argue that all knowledge is "socially produced" by communities of knowledge producers and "is real because it is about an objective world" (Howard & Maton, 2011, p. 195). In response to that, I as the researcher, commenced by identifying who the specialists were in the field of waste management. The results from the study presented in Tables 3.2 and the discussion of knowledge producers in section 4.3 showed that most of the producers, researchers and specialists in waste management have qualifications in the natural sciences. This confirms that the structure of knowledge at this level is hierarchical. According to Bernstein (1996, 2000), natural sciences produce an hierarchical structure of knowledge while the humanities (social sciences) produce an horizontal knowledge structure. In the natural sciences, knowledge integrates at the lower levels and subsumes previous knowledge. This is clarified by examples of waste knowledge discussed in Tables 4.1 to 4.3 where waste management knowledge is traced from examples of waste, to types of waste, categories of waste and then waste processes and procedures. One level of knowledge builds upon another.

The findings also signified that waste management knowledge brought forward the complexity of a multi- and interdisciplinary knowledge 'region' from a critical realist point of view, which is interested in emancipatory knowledge (Bhaskar, 1998). It is multidisciplinary as it is

inclusive of a number of contributions from different disciplines. It is also interdisciplinary as it shows characteristics of emergence from a number of disciplines. The disciplines it emanates from are highlighted in section 4.3. Some of the content knowledge in waste management papers and the officials' data included elements of knowledge from the social sciences which are part of the humanities knowledge field while others showed elements of knowledge from the scientific, health and economic fields. Scientific in this context refers to the natural sciences.

The historical perspectives discussed in Chapter 4 (section 4.4.2) emanating from documents pointed out that waste management knowledge developed and changed with time and space. Waste management once addressed health and aesthetic issues only, went on to adopt scientific approaches to understand the issues of pollution, and then went further to accommodate the economic, public awareness, climate change and technical aspects (Marshall & Farahbakhsh, 2013; see also sections 4.4.2 to 4.4.3). Different aspects of the disciplines were subsumed and integrated as the waste management field developed.

According to Bernstein (1971), when a field contains content knowledge from different disciplines it shows that its boundaries of insulation between it and other disciplines/ fields are blurred. The fact that different disciplines are surfacing and are part of waste management, depicts that the boundaries between its knowledge and that of the other disciplines is gradually disintegrating.

Bernstein (2000, p. 54) further explains the type of knowledge phenomenon noted above, by means of singulars and regions. Singulars are comprised of academic disciplines that address a discourse which is only about themselves. They have specialised knowledge structures. Regions are at the interface between academic disciplines (singulars) and the fields of practice. The classification of knowledge within regions is weaker because the principles used to select knowledge are according to the requirements of the field of practice not according to the structure of knowledge itself. According to Wheelahan (2010), regionalisation is the technologising of knowledge and is inclusive of theoretical knowledge and a field of practice. It is referred to as *applied disciplinary knowledge* which underpins practice (Young, 2006, p. 55). Growth of regions are associated with the growth of professions (Wheelahan, 2010, p. 24). Data in this study, reported in detail in Chapter 3 (section 3.5.1) and Chapter 4 (section 4.3) indicated that waste management is an example of a region, as working in waste management entails putting theory learnt into practice; for example, for one to sort waste, one

needs to know the different types of waste and their properties so that the worker can sort according to the prescribed types of waste and prescribed methodologies. There is a relationship between the knowledge base and the practice.

8.2.2 Analytical Statement 2:

Knowledge and knowers in waste management knowledge construction in the field of production are underpinned by a strong Epistemic Code (ER+) and a weaker Social Relations Code (SR-)

The findings of the second part of this study, reported in more detail in Chapter 4 (section 4.4), discuss the underlying principles underpinning knowledge and the knower in waste management. Maton's specialisation dimension was used to determine the underlying principles underpinning that knowledge. The study shows that waste management is comprised of different types of knowledge (see sections 4.4 to 4.51). The types of knowledge identified from the waste management research considered (see sections 4.4.1 to 4.4.4) and the leading South African legal frameworks (see section 4.5) are discussed in more depth in Chapter 4. As argued in Chapter 2, 3 and 4 there are different types of knowledge namely propositional or declarative knowledge and procedural knowledge or knowledge how. According to the discussion in chapter 4, propositional knowledge ranges from simple factual knowledge to deeper levels of conceptual knowledge and problem-solving. It exists in abstract form and facilitates resolutions of problems such as transfer of knowledge to new situations. Anderson (1982) described procedural knowledge as action oriented and dealing with skills. It depends on people's physical presence and is transmitted through physical cues and face to face discussions. Bernstein (2000) called it horizontal and mundane knowledge.

Findings presented in Tables 4.1, 4.2 and 4.3 portray that waste management knowledge in waste management is inclusive of the different types of knowledge namely propositional or specialised, procedural, technical, social inclusive of people's dispositions, values and attitudes, vocational/craft, practical, historical, legislative and applied economic knowledge. Some of these types overlap, for example, procedural, technical, vocational and practical. They are generated in a context of human action and are termed context-dependent types of knowledge.

As discussed in more detail in Chapter 4, in waste management knowledge presented in research reports and the leading South African legal frameworks, propositional knowledge, processes and procedural knowledge, skills, theory and practice are the dominant forms of

knowledge. Most of the time, theory and practice are limited to instruction in the principles of science and practice applicable to municipalities and industries. In waste management research it was realised that one needs theoretical waste management knowledge to be able to apply it in practical activities conducted in waste management. For example for one to sort, separate, reduce, reuse and recycle, one needs to understand what needs to be sorted and how should it be sorted and for one to treat and dispose waste, one needs to understand the chemical basis of the waste that needs to treated.

Both vocational/craft knowledge and practical knowledge bear the same characteristics, they result from practice, action and depend on activities, they both work with the development of skills; the difference is that they are applied in different contexts. Craft/vocational knowledge is acquired through apprenticeship i.e. learning a skill through a skilled employee while practical knowledge is acquired in any activity dealing with action and practice. Because they deal with *knowledge how*, in this research they are classified under procedural knowledge.

The specialisation dimension contained in Maton's legitimation code theory framework was utilised to analyse the underlying principles of waste management knowledge at the level of production. As discussed in section 4.3, the specialisation dimension has a set of concepts or legitimate codes utilised for analysing the organising principles underlying the practices.

In the documents and legal frameworks discussed in section 4.3, there is an emergence of waste management specialist knowledge from the names of waste types and categories, waste concepts, definitions of waste concepts, explanation of waste processes, the waste hierarchy, procedures of waste management and waste management prevention (scientific/scholarly knowledge). Procedures and processes from collection to disposal are well articulated in the data. Legal frameworks are determinants that things be done according to certain methods and procedures. People cannot practice regulated waste management activities without following waste management procedures and processes. In both legal frameworks, the specialist knowledge in waste management, waste management regulations, norms and technical knowledge emerged and are emphasised. The issues related to availability and unavailability of infrastructure came into view. Issues of planning and reporting related to legal frameworks also surfaced as being significant to waste management knowledge. This knowledge structure emphasises the roles of the managers, the procedures and processes to be followed during planning and reporting, who to consult and who not to consult, reflecting a strong epistemic code (ER+) and a weaker social relation code (SR-).

This does not mean that the social relation code was excluded altogether. As shown in section 4.5.2, an analysis of the DEA Waste Management specialist responses showed elements of aesthetic values and beautification. Most of the waste management specialists joined the waste management sections they are working in because of a love and appreciation of the environment and a concern for health of the people. They wanted to impact on the lives of the people by making communities aware but when it came to what should be prescribed for training of workers at lower levels, they also recommended that the workers at Level 2 of the EPWP be exposed to specialist knowledge in waste management (types, classification, categories and the waste hierarchy), legal frameworks (waste regulations and legal obligations of municipalities) and the roles and responsibilities of the spheres of government. In relation to social aspects, they recommended that workers be taught the values of living in clean environments, impacts of waste on health and the environment, the values of waste for the green economy and the wider value of waste and recycling for society.

From the study's findings, it is clear that both epistemic relations to the object as well as social relations to the subject emerge from the documents, legal frameworks and inputs of specialists but they surface in varying strengths. The knowledge code as an underpinning principle is stronger than the knower code. The findings from the legal frameworks and environment specialists concur with those of the research documents, as they demonstrate that the knowledge code/epistemic relation to the object is stronger (ER+) than the social relation to the subject (SR-). The epistemic relation (ER+) to the object therefore legitimates specialisation within the waste management field of production while the Social Relation (SR) is downplayed. This continua of strengths is visualised and represented as X and Y axes on a Cartesian plane in which the four strengths are identified. The stronger relation is therefore in bold in Figure 8.1 below.

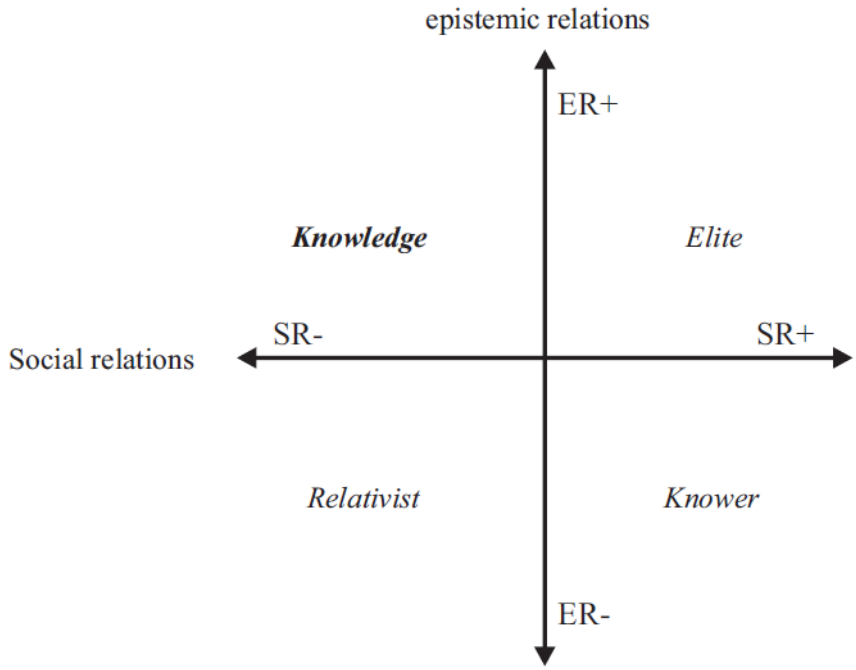


Figure 8.1: Cartesian plane showing knowledge emphasised

8.2.3 Analytical Statement 3:

<u>Recontextualisation of waste management knowledge in waste management qualifications, documents and manuals for worker training is influenced by leading organisations as well as specialists in the field of waste management and also reflects a strong epistemic code (ER+) and weak social relations code (SR-)</u>

In this category, and as shown in detail in Chapters 1 and 5, the recontextualisation of waste management knowledge from the level of production into SAQA waste management qualifications in the Official Recontextualising Field, and learning programmes and learning materials designed by providers in the Pedagogical Recontextualising Field at Level 2 of the National Qualification framework were analysed. According to Bernstein (2000, p. 115), the main activity in the field of recontexualisation is to control the 'what' and the 'how' of pedagogic discourse, by controlling the construction of pedagogic texts and practices, respectively. This recontextualisation process determines what knowledge is to be selected from the field in which it was produced and how it is translated to pedagogic knowledge and practice. Different forms of recontextualisation as analysed and discussed in this study entail the recontextualisation of knowledge from the level of production to the qualification, recontextualisation of knowledge from the qualifications to the skills programmes,

recontextualisation of knowledge from the qualifications and the skills programmes into the learning materials and the recontextualisation of waste management by facilitators into classroom interactions. As explained in Chapter 5 (last paragraph of section 5.2.2), Unit Standard 119555 from the formal Level 2 Qualification in Waste Management and associated examples of SETA accredited learning materials and pedagogical practices from two service providers were utilised to analyse the recontextualisation process.

The analysis of the history and background of the qualification at Level 2 of the NQF revealed that the qualification had been designed by specialists in the field in partnership with the Department of Environmental Affairs and the Institute of Waste Management, a leading organisation addressing waste management issues in the country (see section 5.2). The skills programme developed from the qualification was put together by the officials of the training and development section of EPIP within DEA (as specified in Chapter 5, section 5.2.2) for it to meet the needs of the waste management projects. According to Bernstein (2000), the way these qualifications and skills programmes have been recontextualised portray that their design and development is located in the Official Recontextualising Field, where state control over knowledge is secured. Consequently, the participants in the official recontextualisation process are inclusive of specialist departments and sub-agencies of the state. Their agenda, which was to relocate the official knowledge contained in the waste management legal framework into the pedagogic activities, is clear in the purpose and objectives of the qualification. There is no indication of participation of the acquirers and the providers of training on the selection of knowledge in the design of these qualifications at this level. This explanation shows the status of the struggle for domination of knowledge, which involves the location of control (framing) and the power (classification) in this recontextualisation relationship. Bernstein (2000) called the classification of knowledge the voice of power. In this study, it is clear that state officials are determining waste management knowledge to be included and excluded in the Working on Waste workers' skills training programmes and more widely in Level 2 Waste Management qualifications. The study revealed too that in the context of the focus of this study, official experts are dominating waste management knowledge and training structures and are therefore also dominating the pedagogic device, which shows that their control over the device (framing) is strong (F+). When the framing is strong, the classification (power) which is determined by the level of insulation between the categories also becomes strong (C+). As such, state and field based experts have primary access to and control over the recognition and realisation rules and identity associated with this knowledge (Bernstein & Solomon, 1999, p. 269).

As reported on in Chapter 5 (in section 5.2.2), in the South African context providers of training need to develop the content knowledge for the courses, based on the Unit Standards and Level 2 Waste Management qualification prescriptions (outlined in detail in Table 5.1). These are accredited and quality assured/quality managed by the Education and Training Quality Assurance bodies (ETQAs), in the case of this study the Local Government Sector Education and Training Authority, which in turn falls under the quality assurance structure of the Quality Council for Trades and Occupations for Level 2 work-place based qualifications. The providers working under this accreditation regime are responsible for the recontextualisation of knowledge from qualifications into learning materials and are therefore required to reproduce the official pedagogical discourse to obtain accreditation, with some leeway to contextualise this discourse into local contexts (see section 5.2.2).

In this study, there was a separation in the Pedagogical Recontextualisation Field between the materials designers and the actual training providers, with the materials being designed to provide the tools for the training providers (see section 5.2.3). Evidence from the study presented in detail in Chapter 5 shows that the material designers recontextualised the knowledge from both the level of production (i.e. research-based knowledge) and the qualification (the Official Recontextualising Field) which, as discussed in detail in sections 5.2.3 and 5.2.4, is comprised of unit standards. Unit Standard 119555 was used as the focus of analysis due to its relevance to the object of this study. According to the qualification, Unit Standard 119555 has four outcomes, which were discussed and analysed in detail in Tables 5.3 to 5.5 in Chapter 5, to show the knowledge recontextualisation at this level.

The findings of the analysis presented in sections 5.3.3 and 5.3.4 show that the two providers recontextualised the content of the unit standards differently. The first provider increased the number of outcomes from four to six. He clarified some of the issues, which were not explicitly presented in the unit standards, but he also absented some of the outcomes crucial on the side of the waste management experts, thus selectively appropriating and ideologically transforming the official pedagogic discourse. Their learning programmes, though they originate from the same unit standard, are diverse. One used all the specific outcomes while the other left out some of the specific outcomes prescribed by the qualification in this unit standard. The following are the ones left out by Provider 1 – Respond to and report threats or damage to health, safety or the environment; Recognise environmental risks and discuss principles and concepts related to waste management waste minimisation and recycling. There

was no discussion of the flow of materials to the landfill site. All the activities which take place in the landfill site are not covered in the materials "compile relevant records" as suggested in the specific outcomes. They applied the content knowledge differently. Provider 1 emphasised propositional knowledge more than Provider 2, offering a wider range of more generic waste management information relevant to a wider scope interpretation.

Provider 2, unlike provider 1, utilised all of the prescribed learning outcomes to guide construction of the training programme. Provider 2 divided the unit standard into five sessions. Each session was informed by the discussion of the specific outcome. Each specific outcome was broken down into subsections; in Provider 2's case, local and organisational legislation is included and emphasised. In both cases, aspects of social knowledge were included and limited aspects of economic knowledge, technical knowledge, legal knowledge and planning and management knowledge. As shown in section 5.3.2, the knowledge on offer in Provider 2's materials was contextualised in an urban residential setting or an established municipality. In these materials, a perfect urban waste management facility, its contents and how they function are recontextualised. The materials address how waste needs to be separated and stored in an urban residential area.

The two providers used the same qualification and unit standard but they recontextualised their learning programmes differently. Their learning programmes, though they originate from the same unit standard, are diverse. Though they used the same prescribed model, they recontextualised it differently taking into consideration different contexts. The materials developers relocated and dislocated the knowledge, selectively appropriating and ideologically transforming it to fit their own experience, needs and the needs of the contexts they are conceptualising to work in.

According to Bernstein's framing and classification, when the control of the selection of knowledge and design of the qualification is on the side of the specialists/managers/the level of production, it is declared that the framing in that design is strong (F+). The acquirers and the providers of training on this qualification have no contribution and control in the selection of knowledge in the design of these qualification at this level, therefore their control and framing over this design is weak (F-). On the other hand, it shows that the classification is strong (C+), the boundary between the knowledge prescribed by the level of production and the everyday knowledge of the acquirers is insulated (C-). The leading agents in the field of waste management had managed to maintain their control of power and controlled the 'what'

and ‘how’ knowledge to be addressed. In this analysis there is no flow of waste management knowledge from the receivers of the training into the waste management discourse. As noted above, this recontextualisation regime is based on the underlying principles of a strong epistemic legitimation code (ER+) and a weak social legitimation code (SR-).

This approach to recontextualisation is critiqued by Mukute and Pesanayi (2015) in their experiences for the development of short courses for ecologists. They recommended that recontextualisation in curricula should be informed by contextual policy, theory and practice analysis and stakeholders’ needs-identification. Stakeholders are inclusive of all participants who in the context of this research would be leading departments, leading organisations, institutions at the level of production, qualification designers, learning programme designers, trainers and workers. When one is left out, the participatory contribution of that group in the puzzle is left out, for example, in this one there is no indication of what the workers know, workers do not know and need to know from their perspective. Knowledge of this would assist the content designers to create a form of connection between the known and the unknown and the expectations of the receiving group. Mukute and Pesanayi (2015) recommended that in a recontextualisation process, there should be interaction amongst the contexts, policy, the curriculum designers, the institution of learning or providers of training, the trainers and the learners.

Considering these findings associated with the recontextualisation of knowledge from the Official Recontextualising Field to the Professional Recontextualising Field using Maton’s specialisation dimension shows that P1’s materials demonstrate that the knowledge code privileges specialisation (ER+) within the waste management. Even at this level, one can detect selective appropriations and ideological transformations of the discourse in the recontextualisation process. There is still strong framing (F+), as the control of the selection of knowledge and design of the materials is still largely influenced by the prescriptions of the specialists/managers who have influenced knowledge construction in the Field of Production and in the Official Recontextualising Field where the qualification was designed; however, that the framing is weakening (F to F-) in relation to the Field of Production, as the providers of training in the Professional Recontextualising Field also take up some aspects of control over what they are offering in relation to the unit standard prescription.

Learners, however, still have no control in the selection of knowledge in the development of these learning programmes at this level and therefore their control and framing over them is

weak (F-). One could, for example, consider whether the EPWP workers would have liked to have more training on how to manage waste successfully in a more structured organisational context or waste management facility, and one could surmise that this may well have been a potential area of possibility for strengthening their capabilities for accessing more permanent work, and it may therefore have been met with a positive response from them. As the recontextualisation process is currently structured, there is, however, little opportunity for them to deliberate on this potential choice, which was made for them by the training providers' recontextualisation decisions, effectively excluding them from this learning opportunity. This issue was discussed in Chapters 6, 7 and 8.

On the other plane, it shows that the classification is strong (C+) between the Field of Production and the Field of Reproduction, the boundary between the knowledge prescribed by the level of production and everyday knowledge is insulated firstly by the Unit Standard designers, and then by the training providers who emphasise procedural, technical and propositional knowledge and in so doing exclude everyday knowledge of workers. There is no flow of waste management knowledge from the acquired into the waste management discourse.

As indicated in Table 5.8, the materials of Provider 1 also bear some of the main characteristics and the types of knowledge promoted in the Field of Production, outlined in Tables 4.1, 4.2, 4.3 and further analysed in Tables 5.3, 5.4 and 5.5 in relation to recontextualisaion into the Official Recontextualising Field. Here, in the Professional Recontextualising Field, there is evidence of alignment with the dominant discourse in the Field of Production and Official Recontextualising Field, but deviations have been identified. Training Provider 1's materials excluded organisational and management knowledge. The material designers managed to recontextualise the knowledges suggested by legal frameworks and the specialists in the field of production and in the qualifications, but their points of emphasis varied. Some placed emphasis on scientific knowledge while others emphasised social knowledge. What is missing in this module is organisational planning and management knowledge as well as more locally relevant economic knowledge, both of which could be of potential benefit to workers who are in part-time employment in the EPWP system.

It was noted in Chapter 5 that all three levels of recontextualisation – from the field of production to the official recontextualisation field to the pedagogical recontextualisation field – all failed to include historical knowledge of waste management and applied economic knowledge of waste management which could help workers to a) understand waste based on

their prior experiences and indigenous knowledge (see also Chapter 6), and b) access knowledge necessary for more viable/longer term potential job creation or entrepreuneurial opportunities associated with Level 2 waste management practice. This effectively excludes the workers from making full sense of waste management knowledge historically and contextually, or accessing knowledge that could enable them to build more sustainable work streams from their participation in the EPWP programmes.

8.2.4 Analytical Statement 4:

A code-clash between workers' prior waste management knowledge (from homes and schools) influences the circulation of waste management knowledge in the projects

A code clash refers to a mismatch between old ways and new ways, which is explained by Lamont and Maton (2008) as the mismatch between the code characterising the way one thinks and acts and the code underpinning the basis of success in the context one is acting within (Lamont & Maton, 2008). This section addresses the waste management knowledge and experience the workers brought from their previous life activities (home and previous schools) which influenced the workers' knowledge and the project activities.

The findings reported here are discussed in two chapters, Chapters 6 and 7. Chapter 6 reports on the waste management knowledge and the experiences the workers bring to the project, which is also termed as the dispositions and the experiences the workers bring to the project. The analysis in Chapter 6 shows that workers bring a strong social legitimation code relation (SR+) to waste management knowledge into the workplace based on their previous experience of waste management knowledge from both home and school, with a corresponding weak epistemic legitimation code relation (ER-), as they are generally unfamiliar with much of the scientific and technical discourse associated with waste management knowledge as found in the field of production. This was based on largely contextual and rural-based forms of waste management praxis at home and school which favoured organic waste management practices and burning of mixed waste (which does not accord with waste management legislation or best practice i.e. this should not be done outside of landfill sites, and waste should be sorted and treated according to the waste hierarchy). The analysis in Chapter 6 revealed that the training providers continued to promote a concept heavy approach to their training, prioritising specialisation and high levels of semantic density and low semantic gravity especially as starting points for training (SD+ /SG-). Although they made various attempts to contextualise the concepts, the approach was not based on working from the workers' knowledge and

experience first (i.e. from a SD-/SG+ approach) and then elevating the semantic density from this position (see further comment on this below).

This exploration provides insight into how the flow of information or circulation of knowledge manifests itself through the activities of the project. The main finding here is that the analysis across these two chapters reveals a code clash between waste management knowledge that workers bring into the project and training situation from their previous experiences (homes and schools) (ER- / SR+) and the scholarly knowledge emphasised at the level of production, qualifications and learning programmes as discussed in Chapters 4 and 5 (ER+ / SR-). This is further explicated below.

The biographical data presented in Chapter 6 (see Table 6.1 and 6.2) shows that the EPWP projects that were being studied are implemented in rural towns (as it is the current drive in EPWP programmes to support rural development and work in rural areas). In both projects, all the workers were born and bred in rural areas. Most of the workers studied in rural schools. Only two workers from the second project had studied in tertiary institutions while the rest had never studied at tertiary level. Most of the workers had been doing auxiliary work in their previous jobs. Most of their waste management knowledge is therefore formed by waste management activities and approaches characteristic of those in rural settings. The data on waste management practices of workers from both projects show characteristics of rural backgrounds as explained by Mpako-Ntusi (2002); they practised subsistence farming Informed by those practices, their waste management actions are related to their subsistence agricultural practices, for example: "*They throw the peels of potatoes and cabbages in the gardens as they act as manure and fertilise the soil. They use most of the food remnants as food for animals for example the pigs. Those who do not have animals give the remnants to neighbours*." (Chapter 6, section 6.3.2). It was also noted in Chapter 6 that there is some inconsistency amongst them about how to deal with paper waste; some burn it while others put it into holes and cover it with soil which is a form of composting and also an agricultural activity. Most put plastic and paper together and either bury or burn plastic and paper together. This shows a lack of knowledge of the waste hierarchy and the different composition and properties of waste materials, i.e. that paper decomposes while plastic does not. This is further revealed by practices such as throwing tins and bottles that don't burn well outside the yard close to rivers. According to official waste management knowledge, throwing waste in empty spaces and water courses is a form of illegal dumping that harms the environment. The Waste

Management Act and the Waste Strategy (South Africa. DEA, 2011) requires members of civil society to participate in waste management according to the activities listed below:

- Separate waste at household level;
- Participate in waste awareness campaigns;
- Participate in recycling initiatives;
- Comply with waste regulations, prevent littering;
- Promote waste minimisation, reuse, recycling and recovery of waste;
- Implement the waste management hierarchy with the ultimate aim of diverting waste from landfill;
- Ensure effective and efficient delivery of waste services;
- Be aware of the impact of waste on health;
- Grow the contribution of the waste sector to the green economy; and
- Establish effective compliance with, and enforcement of the Waste Management Act.

Overall, it was clear from the findings reported on in Chapter 6 that the workers brought everyday knowledge from their previous experiences and emphasised this more than specialist, theoretical, or scientific waste management knowledge prescribed by the specialists in the legal frameworks and the field of production (whose examples are listed above). There is therefore a code clash and a mismatch between waste management approaches emanating from their daily practices whose examples emerge in the data and the activities they are supposed to perform in the project. The actions emanating from their way of life, background and home experiences are classified under their social relations. Therefore the social relations to the subject (SR+) are emphasised more than the epistemic relations to the object (ER-). The responses are influenced by the characteristics, attributes, background and the contexts of growth of the workers.

8.2.4.1 Code clashes between waste management knowledge and practices in the field of production and those practised in the workers' previous schools

According to the evidence emerging from the data most of the schools in the rural settings had holes dug for the disposal of waste. Paper, broken panes and plastic were thrown into the holes and burnt. Observations of the practices in the schools illustrate that their practices were influenced by the practices in the surrounding homes. Like in the homes in the schools, contextualised knowledge was emphasised, that is everyday knowledge was emphasised more than theoretical, specialised, conceptual and scientific waste management knowledge. This

also reflects a limited approach to waste management knowledge being offered in the schools which is not adequately preparing learners for more sophisticated, work and scientific related aspects of waste management. This is despite the fact that waste management and environmental health has been included as a topic and principle in the National Curriculum Statement since 1994. It would seem that teachers and school principals are therefore also mainly privileging a strong SR+ and weak ER- in their waste management teaching and practices in the schools, as was also revealed in the data reported on in Chapter 6. It should be noted here that most of the workers who were participating in the study had at least a Grade 10 to Grade 12 qualification (higher than Level 2 on the NQF), which shows that this knowledge is not being developed in either primary or upper secondary education. Even those with tertiary education did not show significantly broad understandings of the specialist aspects of waste management required at Level 2, which points to the possibilities for using campus life as a learning space for waste management knowledge development.

> ***Recommendation:*** *I was not able to investigate this issue in more depth in this study, but I would recommend further research on the epistemic codes being privileged in school-based waste management teaching and learning, especially since waste management offers significant work opportunities (e.g. the DEA 2010 Environmental Sector Skills Plan found that over 30 000 people were employed in environmental occupations in local municipalities around the countries), with potential for entrepreneurial occupations in the waste management value chain (e.g. a study undertaken by the DST in 2010 projected up to 500 000 potential jobs in formalisation of the recycling value chain (DST, 2010)). Given the difficulties in finding secure work, it would potentially benefit learners from rural areas to have a stronger foundational epistemic relation to basic waste management knowledge as it could strengthen learner access and transitioning into those 'green' learning pathways and work opportunities that do exist (e.g. they would potentially know more about landfills and the waste hierarchy, as well as materials and treatment of different waste types, as well as green economy opportunities associated with waste management).*

8.2.4.2 Code clashes in waste management knowledge during the early days of the project

As revealed in Chapter 6, in homes and previous schools, everyday knowledge is emphasised more than waste management specialist knowledge. Evidence emerging from the data revealed that certain types of waste found in the homes were not found in both towns. Those types of waste are inclusive of waste such as kraal, poultry, sheep and goat manure. Evidence emerging from the data showed that in both towns there was infrastructure prepared for the management of waste. In the first town, there were bins and cages made up of steel while in the second there were cement bins but they were broken. In each town there was a municipal truck for the

collection of waste; sometimes it gets broken and waste bags lie in town for days and are opened by stray animals releasing waste into the environment again.

The workers realised that in the town there were different types of settlements i.e. formal and informal settlements. In the formal settlements there was waste management infrastructure while there was none in the informal settlements. The formal settlements and the central business district (CBDs) were benefiting from the municipal services above while the informal settlements were not. The workers indicated that though the formal settlements and the CBDs were benefitting from the services, people's attitudes and behaviours were clashing with the expectations of waste management practices and therefore influenced the status of waste within the towns as reflected in this citation: *"In the formal residential areas and CBD there are bins but people do not care. You would find that the bins are not full but the streets are dirty showing that they do not use the bins properly"* (Chapter 6, section 6.3.2). The workers indicated that the truck collected the waste and took it to the tip where it was burned; some did not know where the waste went after it was put into the cages.

The discussion above displays (as also reflected in the detailed descriptions in Chapter 6) that there is an emergence of waste management specialist knowledge at the level of the project, which includes knowledge of the waste hierarchy inclusive of procedures and processes of waste management and waste management prevention, but there is a lack of sufficient infrastructure and knowledge. In the absence of scientific knowledge and correct infrastructure, what they already know from their backgrounds becomes prominent. Their contextual (rurally influenced) doings and associated knowledge experiences are still evident in their activities in the project.

Evidence from all these three categories displayed that social relations (SR+) to the subject were more emphasised than the epistemic relations (ER-) to the object at the start of the project. The knower code (SR+/ ER-) is emphasised more than the knowledge code (ER-/ SR+), portrayed in the Cartesian plane diagram in Figure 8.2 below.

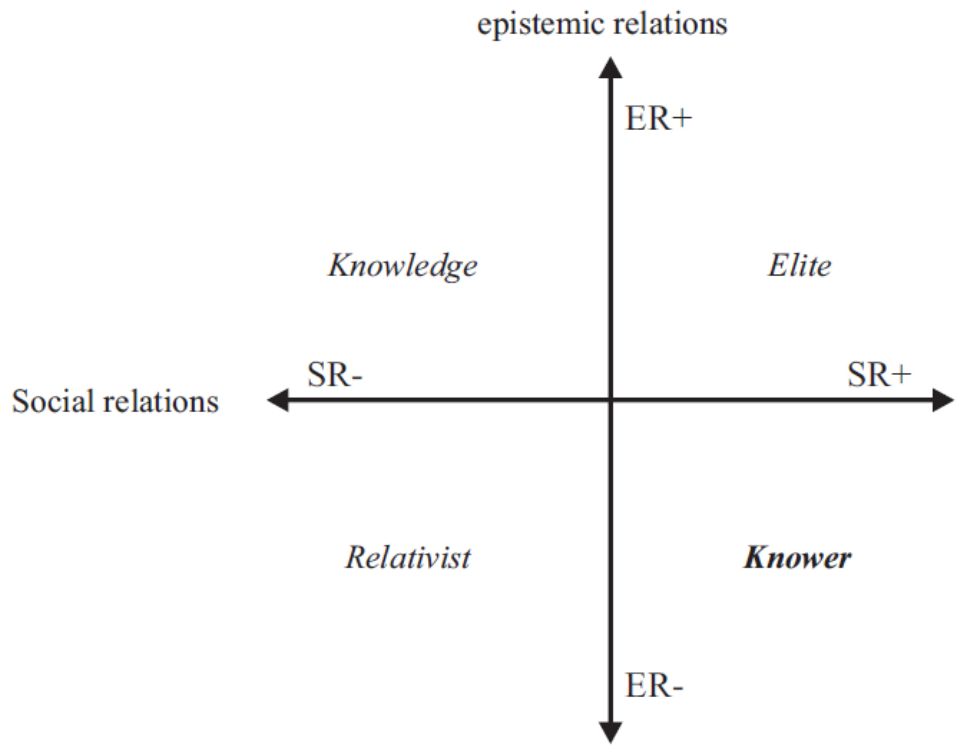


Figure 8.2: Cartesian plane showing knower emphasised

Overall, the social relation to the subject is more emphasised than the epistemic relation to the object. The practices in the schools are also influenced by the practices in the surrounding homes i.e. teachers' and school principal's knowledge of waste management appears to reflect contextualised knowledge resulting in the fact that overall, in the school, contextualised knowledge is emphasised (see section 8.2.4.1 above). Like at home in the schools, the social relations (SR+) to the subject are emphasised more than the epistemic relation (ER-) to the object. The transition from home to school to work is therefore influenced by this knowledge legitimation code, as during the early weeks of the project the evidence illustrated that both epistemic and social relations are emerging as the basis of achievement at this level, with social relations dominating (SR+).

The activities of the Working on Waste EPWP projects seek to expose the workers to specialist knowledge in waste management (types of waste and the waste hierarchy) but the specialist legal frameworks (waste regulations and legal obligations of municipalities) are not put into practice in the activities of the these rural town municipalities, thus producing a performative contradiction in the EPWP programmes. This results in the social aspects, and home practices of the workers remaining dominant (SR+). It is clear therefore that there is a code clash

between the waste management knowledge brought by the workers from their previous life experiences and the waste and waste management specialist knowledge meant to be developed in the Working on Waste EPWP programmes from the start, in part due to the lack of structures and effectively functionality of the waste management system itself in these contexts. Not being explicitly taught the appropriate ways of managing waste at the commencement of the project, due to a lack of appropriate infrastructure and modelled examples, resulted in workers responding to this context by utilising the knowledge they knew, which as mentioned above is characterised by a SR+. Modelling the ER+ through adequate procedures and infrastructure would therefore seem to be important in the initial phases of the Working on Waste EPWP programmes.

> ***Recommendation:*** *There is a need for training of the workers on specialist waste management knowledge very early at the beginning of the project, which should be supported by adequately constituted practices and infrastructure. While everyday knowledge can be a useful starting point for learning, it is not the end point, and there must therefore be adequate opportunities for epistemic transitions. Failure to do so will create a situation where workers are learning very little more than they already know.*

8.2.5 Analytical Statement 5:

Both teacher centred/visible pedagogy and learner-centred/invisible pedagogy approaches influence/are useful for EPWP workers to learn during the reproduction and circulation of knowledge

As reported on in Chapter 7, as the project progressed, the participants underwent accredited training in waste management based on the recontextualised unit standards and the training materials developed. To investigate the reproduction and circulation of knowledge in waste management, observations of formal training activities in Provider 1's case, and interviews with workers in workplaces were conducted as reported on in detail in Chapter 7. The training activities signified the formal part of the training while interviews in workplaces provided a window onto the informal part of their learning gained via experience and practice in the project. The workers were interviewed to establish if any learning had taken place in the project and how the individuals themselves learned and used that knowledge. Bernstein's work on framing (2000) and Maton's (2013) specialisation and semantics dimensions were recommended as having abilities and means to conceptualise the underlying principles structuring fields of knowledge and knowledge reproduction in pedagogic interactions.

South African context, learner-centred approaches to teaching learning are prescribed, but these are often superficially interpreted, as found in this training. The findings of the pedagogic practices, through careful analysis of Provider 1's pedagogical practice using semantic density and semantic gravity as analytical lenses, indicated that the boundaries between the teacher-centred and learner-centred paradigms were not explicit in the pedagogic practice of provider, especially as these related to the use of participatory activities in the training as a means of facilitating acquisition of scientific and specialised knowledge of concepts. The pedagogical practice of the provider was inclusive of elements from both orientations at the level of activity, but lacked a foundational focus on learners' knowledge as the starting point for the training (i.e. the training was based on semantic density (SD+) rather than semantic gravity (SG-) *starting points*, which would have signified a stronger commitment to mobilising learners' prior knowledge at the start of the training programmes, and less of a 'teaching of words' using contextualisation strategies. There were strong elements of transfer of knowledge (in the form of concept after concept with conceptual elaboration of these concepts (see Figures 7.2 to 7.10) from facilitator to students (teacher-centred) and elements of interactions between students and the facilitators (student-centred), especially as a pedagogical strategy to help mediate specialist concepts in the assignment work, and twice as starting points for pedagogy where learners' knowledge was mobilised at the start of the lesson sequence. In outcomes based training as recommended in the learner activities, a more foundational conception of epistemic access based on learners' prior and indigenous knowledge is recommended as a starting point for pedagogical interaction (Lotz-Sisitka, 2009; O'Donoghue et al., 2007). The overemphasis on transfer of concepts (even via pedagogically designed activities) reproduces a pedagogical problem mentioned by Vygotsky who noted that:

> Pedagogical experience demonstrates that direct instruction in concepts is impossible. It is pedagogically fruitless. The teacher who attempts to use this approach achieves nothing but a mindless learning of words, an empty verbalism that stimulates or imitates the presence of concepts in the child. Under these conditions the child learns not the concept but the word, and this word is taken over by the child through memory rather than thought. Such knowledge turns out to be inadequate in any meaningful application. (Vygotsky, 1978, cited in Daniels, 2001, p. 209)

In response, Vygotsky recommended careful *interaction between everyday knowledge and experience and concepts/abstract forms of knowledge in the pedagogical process.* It was interesting to note that in the cases where the facilitator drew on the learners' knowledge to start the concept building process (using the SG+/SD- starting point to SD+/SG- strategy), she received greater responses from the learners. When concept after concept was mediated from

the teacher to the students (using the SD+/SG- starting point and descending semantic wave strategy), there was less response from the learners. The facilitator was the knowledgeable figure in these lessons and directed the activities of the lessons based on the key concepts she was trying to mediate which represented the official pedagogic discourse from the Field of Production. She was forcing the learners to participate actively in the lessons by asking them questions, engaging them in discussions and asking learners to come up with presentations relevant to their contexts and to presenting them as groups. As can be seen in Chapter 7, learners in these activities mainly reproduced their prior knowledge (characterised by a strong social relation SR+); there was not enough *conceptual development* occurring in the activities in relation to the concepts that the educator was presenting. Overall, while learners were able to share their prior knowledge in the activities (including the assessment activities), learners were not given much control over the pacing and sequencing of knowledge in the pedagogic practice and topics for discussion. Their role was therefore relegated to 'manipulated participation' in activities guided and suggested by the facilitator (Lotz-Sisitka & O'Donoghue, 2008) though they did not participate all the time. This indicated that the framing in this pedagogic activity was stronger (F+) as the pacing and the sequencing was controlled by the facilitator and not by learners, thus reproducing the dominant epistemic relation (ER+) via a dominance of semantic density (SD+) in her pedagogical practice, even though attempts were made to realise semantic gravity (SG-) and connections with learners' experiences (SR+).

It would seem therefore that there is an important relationship between framing, sequencing and pacing and learners' participation in this process and *the starting points for pedagogical practice* (i.e. SG+ rather than SD+?) as a means to enabling learners to gain fuller access to strong epistemic codes (ER+). In research focussing on epistemic access, Lotz-Sisitka (2009) noted that starting with learners' everyday experience in pedagogical processes and mediation of a 'reaching towards' more abstract concepts can facilitate epistemological access to propositional knowledge if carefully mediated. She noted too that this *pedagogical approach (using SG+ to SD+)* should not be conflated with the need for well-framed knowledge trajectories (ER+). In other words, the semantics of the pedagogical process should not be conflated with the epistemic relation; i.e. a strong Epistemic Relation (ER+) does not necessarily require a SD+ to SG- pedagogical process. This is also a key focus of post-Vygotskian pedagogical research, where the *dialectical* relation between intra- and inter-mental relations, learning processes and pedagogy are considered in more depth.

Recommendation for further research: *In this research I was only able to touch the surface of this pedagogical process problem and would recommend further research into the pedagogical relation between the sequencing of SG+ to SD + approaches and epistemic access to strong epistemic codes (ER+). As yet, I have not found studies that relate the Vygotskian work to the SG+ and SD- work of Maton's Legitimate Code Theory from an epistemic access point of view. This would therefore seem to be an important area for further research.*

8.2.6 Analytical Statement 6:

<u>At the level of reproduction EPWP Level 2 waste management training – as observed in the study – is underpinned by the knowledge code (ER+ / SR-)</u>

As shown in Chapter 7, in the pedagogic activities of Provider 1, three aspects were emphasised namely 1) specialised knowledge, inclusive of propositional knowledge, skills, processes and procedures of waste management, 2) legal frameworks in waste management, and 3) social aspects of waste management. In mediating specialised knowledge in the form of concepts, propositions, skills, processes and procedures, the facilitator placed emphasis on the explanation of concepts and terms, for example, what is waste, types of waste, classification of waste categories, types of pollution i.e. air, water and land, and offered further conceptual elaborations associated with each of these. As she progressed she gave the examples of each from the context. She connected the waste terms and the processes and procedures of the waste hierarchy with the legal frameworks. She also sought to include social knowledge, as she tried to emphasise in every unit that waste is the responsibility of every human being and that waste was created by unsustainable human activities. These pedagogic practices illustrate that both social and epistemic relations were emerging in these practices. Chapter 7 shows, however, that the epistemic relations (ER+) were dominant over social relations (SR-) seen via the emphasis on teaching concept after concept. The expectation is then that the learners must apply that knowledge in waste management activities in the projects. The transitioning process from concept to application was largely left up to the learners to achieve on their own.

Recommendation: *There is need for a greater balance between ER+ and SR+ in the waste management epistemic code in the EPWP training at the level of reproduction so that learners at Level 2 in the EPWP programmes are not largely 'left' to achieve the transitioning process from concept to application on their own.*

8.2.7 Analytical Statement 7:

Assessments observed in the EPWP formal pedagogic activities are underpinned by the knower code/ social relation to the subject, but are largely diagnostic and based on prior knowledge and experience

Observations of Provider 1's training, reported in Chapter 7, showed the opposite pattern to the pattern found in the pedagogical practices where the knowledge code was strong (ER+/SR-). In the assessments, the status of events was different and learners were discouraged from reproducing the concepts and procedures as given and described by the facilitator in class; instead they were encouraged to come up with their own examples relevant in their own communities. There were no standardised answers. Evaluation was not about reproduction of content or elaboration or further development and wider application of the concepts being taught, but about prior experiential application of the content in the contexts of their communities. The results of the assessments were not about high marks or correct answers but about the ability of the students to apply the knowledge in their communities, drawing on prior experience. In assessments therefore, the social relations (SR+) to the subject were emphasised more and the social relation (SR+) was therefore stronger than the epistemic relations to the object (ER-) which was weaker and downplayed.

This approach to assessments could potentially be constructive and practical for training in Expanded Public Works Projects at Level 2, as the purpose of the training is to facilitate creation of waste management skills which can be applied in the municipalities. However, the approach might be more beneficial to learners if the applied assessments were based on the new concepts being taught, rather than simply relying on their prior knowledge and experience of the concepts i.e. there should be *a stronger transitioning relation* between the strong epistemic relation (ER+) of the concepts being taught using strong semantic density (SD+) of the concepts being taught and the social relation / semantic gravity (SG- / SR+) of the assignments.

It seems that more attention needs to be given to the role of assessment and evaluation activities in the *transitioning relations between concept and context in waste management knowledge.*

> ***Recommendation:*** *To maximise the learning potential of contextualised assessment practices, more attention could be given to how these interface with the new concepts being learned, rather than using them as diagnostic prior assessment of knowledge only. As this was found only in the pedagogical practice of one provider, I also*

recommend further research into the semantic gravity wave as found in, and formed via assessment practices.

8.2.8 Analytical Statement 8:

Both context-dependent/contextualised and context-independent/decontextualised knowledge contributed/contributes to knowledge building and circulation of knowledge at the reproduction level; but context-independent/decontextualised knowledge dominates the knowledge circulation process in the EPWP Level 2 training

Chapter 7 shows that there are semantic waves moving from both the high flat line to the low flat line (downward semantic shifts) and from the low flat line to the high flat line (upward shifts) but the downward semantic shifts are more emphasised than the upward shifts. The downward shifts were produced from the condensed, decontextualised ideas (SG-/SD+) to more simple concrete understandings (SG+/SD-) with the former dominating the semantic wave pattern in almost all instances of Provider 1's pedagogy (see Table 7.3), reflecting the dominant pedagogical assumption commented on above. This has implications for the learning of waste management knowledge and waste management praxis in the EPWP programmes. According to Maton (2013, p. 10) in specific contexts, when teaching tilts from the weaker to the stronger semantic gravity, effectively leaning towards the contextualisation of concepts, the accumulation of knowledge can be compromised as facilitators concentrate on unpacking concepts without returning to the original purpose of the lesson and reason for embarking on the learning of the concepts in the first place. This seems to have been the case for Provider 1 as she ended up constantly clarifying concepts with further conceptual elaborations through unpacking of them to the lower flat line.

While this is the case, the moves between stronger semantic density and weaker semantic density that were made were useful because of the purpose as well as the level of competence of the workers in the field (i.e. there was need to make strong connections to experience and context) for meaning to be made and for workers to be able to apply the concepts in their contexts of practice.

Currently the assumption of the whole training system (Field of Production, Field of Recontextualistion) appears to be that this is a 'one-way' transitioning relation i.e. from conceptual acquisition to contextual application. There is little critical engagement with this approach. This raises questions about how concepts are formed. The post-Vygotskian literature on how concepts are formed, proposes that concepts are learned via the theoretical principle of

ascending from the abstract to the concrete (Engeström, Nummiijoki & Sannino, 2012). Engeström et al. (2012) explain that:

> A theoretical concept is initially produced in the form of an abstract, simple explanatory relationship, a 'germ cell'. This initial abstraction is step-by-step enriched and transformed into a concrete system of multiple, constantly developing and expanding manifestations. In other words, the initial simple idea is transformed into a complex new form of practice. (p. 2)

This proposes an approach that uses increased sophistication and engagement with concepts over time following 'ascending' semantic waves from SD+ to SG+ that was found to be dominant in the pedagogical practice of Provider 1. However, the citation above suggests that this is more complex than repeated SD+ to SG+ descending 'waves' that occur in the facilitators' dialogue, and instead involves 'a concrete system of multiple, constantly developing and expanding manifestations', which would seem to suggest regular concrete experiments with concepts in practice.

Given the above mentioned assumptions of the dominant epistemic transitioning movement from concept to application in practice after learning the meaning of a concept, it was expected that workers would learn the concept during the training session (where decontextualised meanings were made more explicit using examples) and that they would then apply it after the training in the project contexts. Thus **the dominant pattern of knowledge circulation appears to be *descending* ER+/SR- and SD+ /SG- with *consistent descending* transitioning movements to ER-/SR+ and SD-/SG+, but *inconsistent or absent ascending movements from* ER-/SR+ and SD-/SG+ to ER+/SR- and SD+/SG- for the learning of waste management concepts in practice**. As noted above, this dominant pattern could be considered more critically, a process which would also need to be the subject of further research.

> ***Recommendation for further research:*** *This finding from this study points to the need for further research into how concepts in waste management are formed over time, and further research into the specialisation and semantic relations of this ongoing process is required.*

In the engineering context, which is also of interest to waste management knowledge, Winberg et al. (2016) recommended that "simple and more complex application contexts need to be balanced to achieve an appropriate level of semantic density, more simple application contexts will reduce the semantic density, while more complex contexts will increase it" (p. 14). Here they suggest that the contexts of practice offer different possibilities for learning complex

concepts; these are not only learned in classroom contexts via facilitated discourse and activities. Also in the context of engineering education, which has some resonance with waste management knowledge as much waste management knowledge originates from the engineering sciences as explained in Chapter 7, is the need to 'balance' the semantic waves for epistemic access by increasing and decreasing contextual complexity and semantic density. They suggest that

> Enabling passage across the epistemological transitions is central to a transformative approach to curriculum; it requires pedagogies that are inclusive and that can engagement students in the full professional knowledge system … *Key to the provision of epistemological access is control of the semantic gravity wave*. (p. 14, my emphasis)

They (ibid.) recommend a semantic gravity range from SG- to SG+ involving transitioning movement from decontextualised (SG- / SD+) to everyday contexts (SG- / SD-), moving along to simple application contexts (SG- / SD), and then moving along further to (SG+ / SD+) along an increasingly sophisticated and expansive conceptual and contextual trajectory, expanding epistemic access and increasing sophistication of knowledge and praxis applications over time. While the Winberg et al. (2016) recommendations are made for tertiary level engineering studies, there are some useful insights to gain from this for waste management knowledge circulation and learning and associated pedagogical practices, the most basic being a more balanced transitioning pattern that can be enabling of epistemic access while also achieving the applied learning purpose of the knowledge field.

> ***Recommendation:*** *I would recommend that more attention be given to 'balancing' and controlling the semantic gravity wave in the EPWP Level 2 training programmes. There is need to balance the* ***dominant descending transitioning pattern of knowledge circulation from ER+/SR- and SD+/SG- to ER-/SR+ and SD-/SG+ with more*** **consistent ascending movements** ***from ER-/ SR+ and SD-/ SG+ to ER+/SR- and SD+/ SG- for the learning of waste management concepts in practice****.*
>
> ***Recommendation for further research:*** *As this recommendation is based on a generally established dominant epistemic relation (ER+/SR-) pattern in waste management, and on the observation of the code clashes noted above, but only on the observations of one pedagogical setting, I also recommend further research into this knowledge circulation pattern, and especially into practices that can shed light on how to better establish control and balancing of the semantic gravity wave for enhanced epistemic access in more pedagogical settings than what I was able to observe in this study.*

8.2.9 Analytical Statement 9:

Reproduction and circulation of knowledge in the waste management formal and informal pedagogic interactions brought about a change / impacts in the lives of the EPWP workers

As reported on in Chapter 7, the workers were interviewed for a second time after the they had spent seven months in the project and after participating in waste management accredited training. Evidence presented in Chapters 6 and 7 indicates that workers were not informed about the scientific knowledge and processes in waste management at home, school and during the first weeks of the project. During the first interviews at the beginning of the project they did not have knowledge of the processes of the waste hierarchy. They were largely ignorant of the fact that disposal in the landfill site should be the last resort. They had their understanding of everyday waste management knowledge which says that waste should be burnt, and that waste should be collected from one's surrounding and be thrown into empty spaces or buried.

During their six months of participation in the project, through interaction with other stakeholders, evidence indicates that their scholarly scientific waste management knowledge was strengthened as shown in the citations in Chapter 7. In particular, they learned more about recycling practices (the technical aspects thereof) and that recycling brings an improvement to people's lives. They learned that there were alternatives to burning waste (i.e. landfilling) and that waste can also be used as a resource to benefit people (i.e. economic knowledge). They also learned about people's attitudes and behaviours towards waste and the influence of these human factors. They learnt how to make compost. They learned these things through observation and practice and through exposure to scientific concepts and knowledge as in the training exercises. They learnt that improvisation is key in the management of waste and that one does not need always need to depend on bought equipment.

During accredited training, the workers in Case Study 1 were taken for a field trip to a licensed landfill site, where some realised for the first time that there was no landfill in their town municipality and what they thought was a landfill was a dumping site. At the landfill, they observed various technical waste management procedures e.g. that waste is weighed, and some waste is not allowed into the landfill, for example, hazardous waste, hospital or health related waste and electric appliances. Recyclables are separated and sorted, collected and removed for recycling. When recyclables have been removed, the remaining waste is compacted and covered with soil. They noted that there was no burning, no scavengers and people were not

allowed in the landfill. This contrasted with their local and historical knowledge and experience showing that site visits are also a powerful tool for developing semantic density SD+, reflecting some of the 'semantic gravity wave' that Winberg et al. (2016) referred to (see above). In this case, movement from simple application contexts (own town and dumpsite) (SG-/SD-) to more complex application contexts (the functioning landfill site) where SD+ and SG+ are both possible.

During the seven months of participation in the projects and during accredited training on environmental practice, two codes of knowledge emerged from their activities: the knowledge code (ER+) and the social code (SR+). The knowledge code demonstrates that the waste management knowledge acquired through participation emphasised waste management specialist knowledge, waste management processes, procedures and skills which shows that it is oriented towards the object. The social code is illustrated by the part of waste management knowledge that puts emphasis on attitudes and behaviours of the people. Maton (2010; 2014) argued that all the fields have both knowledge and social codes but one may be stronger (ER+/SR-) than the other while the other is downplayed or weaker and vice versa (SR+/ER-). A field can emphasise both (ER+/SR+) or display none (SR-/ER-). As their participation expanded in the EPWP projects, the epistemic relation changed from being primarily ER+/SR– at the beginning of the project, to being ER+ and SR+ (stronger, but still not dominant) as the project progressed. Workers consequently made commitments to influence the following processes at home, the environments around them, and in the EPWP projects:

- "Need to avoid creating waste";
- "Need to learn to reduce waste, there should be routines in municipalities and workers need to stick to it";
- "Need not burn waste even at home";
- "Need to recycle waste and treat it as a resource";
- "Need to conduct awareness raising and educate the business people and hawkers in rural towns"; and
- "Even in rural areas they need not burn but recycle".

This data shows a stronger balance between the knowledge code ER+ (e.g. do not burn; avoidance; reduce; establish routines; recycle; treat waste as a resource) and the knower code SR+ (e.g. don't burn at home; establish routines in municipalities; educate business people and

hawkers; conduct awareness raising; rural areas can recycle) than was found at the start of the project.

8.2.10 Analytical Statement 10:

<u>There is a disjuncture between waste management policies and waste management practices on the ground; this impacts on the circulation of knowledge in the EPWP projects</u>

The Oxford Dictionary (1997) traces the meaning of 'disjuncture' from the word 'disjoin' which means (separate/disunite) so disjuncture means there is disunity/a disconnection of views between waste management policy and practices at grassroots level which influenced learning in the EPWP projects; in the case of this study, this is in rural municipalities.

As mentioned above, not everything that appears in waste management policies and strategy is materialising in practice. Many of the practices taught in the waste management courses do not match with waste management practices in the municipalities. To show the disjuncture between policy and practice, I summarise the issues raised by the participants, which reflect a range of non-compliance issues related to waste management policies:

- "*We throw the plastics, tins and bottles in a hole in the garden*" – The waste needs to be sorted and separated according to legal frameworks.
- "*Waste is taken to the tip and burned*" – This is not legal according to the Waste Management Act.
- The so-called landfill sites [dumpsites] are overpopulated by people collecting the recyclables and food.
- There are no municipal services in the slum area and no toilets. This area is next to a river. All sorts of waste is deposited next to the river, with implications for what happens when it rains. "*No cleaning takes place there*".
- In some municipalities there are no trucks to collect and transport waste to the landfills.
- In some municipalities there are no recycling facilities "*The tins are collected by a group of mothers who collect the tins. He says they collect them, compact them and take them to Durban.*"
- "*Even in the rural areas there are dumping sites, when people are renovating their homes and changing carpets they throw that in the open spaces which end up as dumping sites and everyone is dumping there*."

- In the formal settlements there is waste management infrastructure but there is none in the informal settlements. The formal settlements and the central business district (CBDs) benefit from municipal services, while the informal settlements do not.

- The trucks do not get to the households so they have to bring their waste onto the routes of the trucks for collection. They do not sort. They mix everything in one plastic bag.

- *"The trucks deliver the loads in the landfill (tip). It is burned, after burning it is compacted with road-roller machine."*

Unavailability of infrastructure and non-compliance to waste management legal frameworks in municipalities contribute to challenges and the problematic situation that provided the motive for this study i.e. going back to the original state when the EPWP projects have come to an end. As noted above, the workers are learning new waste management practices in the EPWP programmes, but without adequate infrastructure and properly functioning systems, this can be less than effective in the longer term. The need for environmental awareness in municipalities identified in the waste strategy should be treated as a priority, with proper support for system development of the necessary infrastructure to ensure compliance with legislative frameworks.

8.3 IMPLICATIONS OF THE STUDY'S FINDINGS FOR WASTE MANAGEMENT EPWP PROJECTS AND THE CIRCULATION OF KNOWLEDGE SUPPORTED THROUGH EPWP TRAINING PROJECTS

As noted in Chapter 1, this study focussed on skills development initiatives in waste management within the Environmental Protection and Infrastructure projects of the Expanded Public Works Programme within the wider field of Environmental Education and Sustainable Development. These projects are funded under the umbrella of the EPWP, which is a programme that was established by government to create employment and alleviate poverty in South Africa. Waste management is the focus of the Working on Waste programme. The strategic objectives of this focus area are to create and support mechanisms for the protection of environmental quality, creation of sustainable livelihoods through the recycling of waste, to support the use of environmentally friendly waste disposal technologies and promote waste management education and awareness in the communities (DEA, 2013).

While working in the projects, the workers undergo training. The knowledge and skills transferred to the workers should be relevant to the particular EPWP project and the needs of the communities around the project. The training and experiential learning is intended to improve the employability of the workers when the EPWP projects come to an end. Also

implied is the fact that the workers' participation on the EPWP project activities, whether waste management or environmental education, will impact on the state of the environment; for example, if the area had a problem of litter and waste, the outcome would be better waste management in the future, but sometimes at the end of the project, the state of affairs after the project has come to an end returns to how it was before the project commenced. This study sought to understand the status of waste management knowledge, how knowledge is recontextualised via pedagogy and knowledge circulation and building in relation to the purpose of this training which is offered to workers at Level 2 on the NQF.

This study took as its focus rural towns in the former Transkei region in the Eastern Cape. This area has been on the forefront in accessing funding for these projects due to the level of poverty surrounding these towns and the inability of the local government sphere to deliver on its mandate in the region. It is within this context that the implications of this research to EPWP are discussed. The questions guiding the study are stated in section 8.1 above and the main findings of the study are presented in section 8.2. Specific recommendations have been made in relation to the specific findings above, where relevant. In this section I therefore focus only on additional implications and recommendations.

Worldwide, EPWP is employed as a social protection programme to meet the dual challenges of short-term poverty reduction and long-term asset creation (Koohi-Kamali, 2010). In South Africa, it is matched with skills development to enable learners to progress to higher levels of education from any starting point (ANC, 1994). These are the two issues which are the focus of this research. Here I will summatively reflect on the assets created, workers learning for progressing to higher levels of education and the knowledge they gain in the process. In the context of waste management, the assets are clean environments even after the project has come to an end.

This study has shown that Waste Management is an inter-disciplinary 'region' meaning that it is inclusive of both theoretical and applied practical knowledge. It is also comprised of epistemic relations to the subject and social relations to the projects though the epistemic relations are stronger on the continuum. The knowledge aspects address the waste management specialised aspects while the social aspects give attention to how the people impact on the environment. This is crucial and important for EPWP workers. It serves the purpose for the programme as the workers need to acquire new specialised knowledge as they do not come with this from home and school as shown in this study and they also need to learn to apply it

in the activities of the project. Thus, the knowledge structure characterised by a strong epistemic structure (ER+) is necessary for expanding workers' knowledge of waste management and addressing the specialised nature of waste management. As shown above, this does not exclude inclusion of social relations (SR). The study has shown that workers come to waste management knowledge with a strong social code (SR+). The study has also shown that there is some movement via the formal and informal learning processes towards strengthening social relations of the knowledge structure via pedagogical activities and praxis experiences, addressing the initial code clash and moving towards a stronger balance between ER+ and SR+, even though ER+ remains dominant.

A key challenge identified in the study is the relation between the strong epistemic relation, and the structuring of semantic gravity waves (i.e. pedagogical process patterns) that allow for more balanced semantic gravity waves i.e. movement between dense concepts and meaning units and workers' knowledge and experience. Management and structuring of the semantic gravity wave appears therefore to be an important issue to be addressed in EPWP training programmes which relates to when and where workers receive formal training and how the training is structured for recontextualisation at the level of reproduction. This could also assist with addressing the code clash noted above, where social relations to the subject are more emphasised than their epistemic relation to the object (Maton, 2000), thus excluding workers from accessing waste management theoretical knowledge as prescribed by historically constituted communities of knowledge producers in the field and associated legal frameworks in the field of production (Bhaskar, 1998; Wheelahan, 2010). As argued in Chapter 7, this has consequences for workers' empowerment, and for creating possible learning pathways into green jobs or more sustainable work opportunities, moreso if the recontextualising process itself also excludes important knowledge areas such as historical or economic knowledge.

The issue of *inclusivity of knowledge* i.e. to include workers' knowledge, historical knowledge, economic knowledge *as well as* scientific propositional and technical knowledge would seem important to achieve a more balanced knowledge flow environment that could allow for epistemic access, especially via pedagogical strategies that promote a more balanced semantic gravity wave, that includes not only a dominance of descending trajectories (SD+/SG- to SG+/SD-), but a more balanced system of *descending and ascending* semantic gravity wave patterns, where possibilities for mediating higher semantic density and semantic gravity through more complex practical applications (e.g. as in the excursion to the landfill that

occurred in Case Study 2) are considered in the pedagogical planning, or where assessment activities are more carefully defined to not only measure prior knowledge in a diagnostic sense as in the case of Provider 1's practice, but are used to develop the semantic wave ascending patterns towards understanding of critical concepts and more complex applications of knowledge in praxis contexts. As indicated by Winberg et al. (2016) in a higher education engineering education context, management of the semantic gravity wave is crucial for enabling and enhancing epistemic access.

Thus, timing and sequencing of training activities that allow for *ascending and descending semantic gravity waves towards more complex application contexts* for enabling epistemic access therefore appear to be an important issue to consider in the planning and structuring of EPWP training. Not being exposed to this pedagogical practice in the context of a strong epistemic code (ER+) resulted in workers not knowing how to respond to and act according to the specifics of the knowledge producers, that is appropriate scientific and technical ways of managing waste at the commencement of the project. All they could do was therefore utilise the knowledge they knew. The knowledge they knew and brought from their previous experiences was inadequate, and even detrimental to the environment. Thus, there is a need for training workers on specialist waste management knowledge very early at the beginning of the project, but such training needs to draw on their knowledge to allow for epistemic access and the building of concepts into more complex practices and conceptual constellations over time. It would therefore seem important to emphasise the *ascending* semantic gravity wave in pedagogical practice early on, *balancing this with subsequent descending and ascending semantic gravity waves towards more complex acquisition of concepts* (i.e. the conceptual elaborations that were put forward in the training), but also more complex contexts of application (as shown to be possible via the landfill site excursion). Figure 8.3 below illustrates the proposed model for managing the semantic gravity wave, which also shows the relationship between semantic density and semantic gravity for a strong knowledge code (ER+) knowledge structure, which via pedagogical practice orientated towards epistemic access, can also offer a stronger balance between ER+ and SR+, thus addressing the code clash identified in this study.

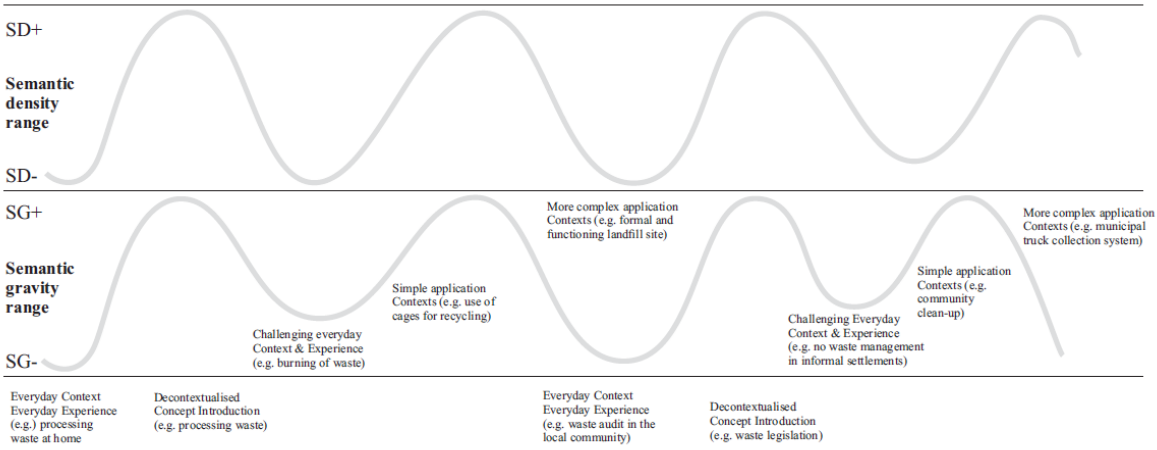


Figure 8.3: A proposed model for managing the semantic gravity wave in waste management training in EPWP projects, showing the relationship between semantic density and semantic gravity for a strong knowledge code (ER+) where concepts and conceptual elaboration are required, but where epistemic access to these concepts requires attention for efficacy, meaningful learning and knowledge building (adapted from Winberg et al. 2016, for EPWP Level 2 Waste Management training)

The significance of the model presented above in Figure 8.1 is reflected in this statement by Wheelahan (2010, p. 2) where she reflects on the work of education sociologists Bernstein (2000) and Young (2008) who argued that,

> Theoretical knowledge is a precondition for effective democracy; it is a means society needs to make connections between objects and events. Access to it is important as it provides access to society's conversations about itself. It includes how society should respond to threats such as global warming. While all jobs need context-specific knowledge they also require knowledge involving ideas shared by communities of specialists located within the fields … Workers need access to the theoretical knowledge that underpins their occupational field of practice if they are to participate in the debates within the fields. (Wheelahan, 2010, pp. 2-3)

Bernstein (2000) asserted that recontextualisation mediates the way knowledge is classified and influenced by members of the field, reflecting competing perspectives about human nature and the purpose of education. It is concerned with relocating, refocusing and picking up issues from other discourses to build its own order. It considers what matters and why it matters in that particular field. The above elements have been utilised in the understanding recontextualisation processes in this study. At the level of design of the training courses at the level of qualifications and skills programmes, results of the study potrayed that the experts in the field in the form of leading organisations and leading officials dominated the recontextualisation. What matters to them was well articulated. They managed to relocate their

agenda into the qualifications and training programmes which was meant to provide strong epistemic guidance on how to educate the communities about waste management frameworks. The leading agents in the field of management had managed to maintain their control of power and controlled the 'what' and how knowledge is to be addressed.

At the level of development of materials, materials are developed by centres and providers. Though they used the same prescribed qualifications, they recontextualised it differently taking into consideration different contexts. The material developers relocated and dislocated the knowledge, selectively appropriating and ideologically transforming it to fit their own experience, knowledge, and their perceived needs of the contexts, they were conceptualising the training for. The study showed that even if the context that they are doing the training in (e.g. rural waste management) differs from the one they had prepared themselves to work in (e.g. urban waste management), they don't actually adapt the materials; they use them as is, which gives rise to pedagogical process challenges and the pattern of repeated descending semantic gravity waves as observed in Provider 1's case.

Overall, there was no flow of waste management knowledge from the receivers of the training into the waste management discourse. Despite participatory activities that ask them to share their knowledge, *their epistemic contribution is largely left out in* ***the knowledge building process***, which results in a 'teaching of concepts to them with examples' (i.e. a descending dominance), rather than an approach that allows them to build concepts from their existing knowledge and experience (i.e. a more balanced ascending-descending-ascending-decending semantic gravity wave – see Figure 8.1 above). *There is no effort made, by any of the recontextualisers in the system of recontextualisation to find out what the workers know, what they do not know, and / or need to know from their perspective*; and how this relates to the wider structural challenges of waste management noted above. This illustrates that in the EPWP programme there is a need for theory and practice analysis, and stakeholders' needs-identification in waste management projects before the training programmes are designed. Such a process would assist the content designers to adapt their materials to inform the pedagogy and create a form of connection between the known and the unknown and the expectations of the receiving group as illustrated in the model presented in Figure 8.1. It would also make the implementation of the model presented in Figure 8.3 possible in EPWP training.

The South African education policy proposes that the utilisation of invisible pedagogies or learner-centred approaches is recommended. The results of this research show that in the

EPWP training context, this concept is poorly understood and practised in learning materials design, in training, and in assessments. The study pointed to instances where this approach was used and noted that in such cases, workers were more responsive to the training, indicating that to expand EPWP workers learning and knowledge, both teacher-centred/visible pedagogy and learner-centred/invisible pedagogy approaches could be useful, as also pointed out in the model presented in Figure 8.3. Both context-dependent/ contextualised and context-independent/ decontextualised knowledge contributes to knowledge building and circulation of knowledge in the field of reproduction; but this also needs to be planned for in the official and pedagogical recontextualisation fields. This includes extending such planning to the assessment design and planning, as also pointed to in Chapter 7 and in the discussion above. The potential for expanding learning through a good mix of on-site training, experiential learning and formal training was shown in the study as by both accredited training and participation in waste management projects, through interaction with other stakeholders, workers were able to develop aspects of their scholarly scientific waste management knowledge, although more could have been done to make this process more effective, as pointed out in Chapters 5 and 7.

In concluding this thesis I make the following recommendations (in addition to those made above):

> ***Recommendation:*** *There is need to give more attention to workers' prior knowledge and experience and the structural conditions that influence waste management practice and learning in the EPWP training projects. These understandings should be used to inform the design of skills programmes, learning materials, as well as pedagogy and assessment practices in ways that strengthen epistemic access and* ***knowledge building*** *as modelled in Figure 8.3.*
>
> ***Recommendation for further research:*** *As the model presented in Figure 8.3 was based on two case study sites and detailed observations of actual training practices in one of the two sites only, there is need to further test this model via application to other training contexts and training sites.*
>
> ***Recommendation:*** *As shown in this study, workers spent considerable time using their everyday knowledge in the activities of the projects which promoted use of unacceptable ways of waste management. The workers need to be exposed to waste management theoretical knowledge/ specialist knowledge (accredited training) very early in the project to introduce correct procedures and legal frameworks which will inform their activities in the projects. This must, however, be done with due recognition of workers prior knowledge and experience, and should be done in a way that reflects good management of the semantic gravity wave, as illustrated in Figure 8.3.*

Recommendation: *More attention should be given to a systemic approach to waste management in rural areas where EPWP projects are being implemented. This includes giving attention to the attitudes of people to waste management in the rural towns, which includes public education of citizens, businessmen, political leaders, and municipal staff in rural towns. The emphasis should be training them on how to use waste as a resource for local development, thus potentially opening up economic opportunities for workers who have learned about waste management in the EPWP projects; i.e. a more systemic approach should be taken to thinking about training and EPWP projects. This should include a focus on improving compliance in relation to the Waste Management Act and improving the infrastructure and facilities for waste management practice so that a proper context for waste management learning can be created to support the training and other investments made in the EPWP projects. Additionally, measures should be implemented to improve the transport facilities for collection activities, recycling facilities and licensed landfill sites; these are an urgent priority in municipalities – without them the work conducted by EPWP projects would seem to be in vain. Without trucks there is no collection and dogs reopen the bags, without recycling facilities recyclables are sent to landfills and burnt, without a licensed and well equipped landfill there is burning of recyclables which leads to the extension of the challenges of climate change. All of this contradicts with the formal waste management knowledge that is promoted by knowledge producers and official and pedagogical knowledge recontextualisers, which ultimately creates a performative contradiction in the EPWP project, which cannot be resolved through improved knowledge mediation amongst workers only. Thus the effective application of the model presented in Figure 8.3 will depend on improving knowledge, learning, compliance and infrastructure in other parts of the waste management system in rural areas.*

8.4 CONCLUSION

This study set out to investigate the construction, recontextualisation and circulation of waste management knowledge in EPWP Level 2 worker training programmes. As argued in Chapters 1 and 2, there is little research done on the construction, recontextualisation and circulation of waste management knowledge in workers' training, and even less in the context of Level 2 waste management qualifications on the South African NQF. The study investigated the production of waste management knowledge in the field of production, focussing on the African context more broadly and on the South African context more specifically, as it pertains to the purpose and interest of waste management training in the EPWP programmes. Furthermore, it investigated the structuring and recontextualisation of this knowledge by official and pedagogical recontextualisers in the Field of Recontextualisation, pointing out that the principles structuring this knowledge is strong epistemic code (ER+) and weak social relations code (SR-). It investigated workers' knowledge of waste management, with emphasis

on rural workers whose knowledge and experience of waste management was found to reflect a strong social relation (SR+), pointing to a code clash in the EPWP waste management training context. It observed training in some detail in one case study site, seeking to illuminate the way in which pedagogical and assessment practices related to and/or responded to the structuring of knowledge and the aforementioned code clash and also sought to gain insight into what workers were learning from accredited EPWP training and informal learning through practice in the EPWP projects. The study found improved understanding of specialised waste management knowledge over time and a slight balancing of the ER+ /SR+ relation. It, however, identified further possibilities for improving the training, especially through improved management and structuring of the semantic gravity wave, in which the dominant pattern of descending semantic density could be changed for greater epistemic access via a more balanced ascending semantic gravity pattern (as starting point), complemented by ongoing descending and ascending semantic waves to enhance workers' participation in knowledge building via more complex conceptual and contextual engagements over time. The study also pointed to the need for a more inclusive knowledge framework for waste management training, especially in the field of recontextualisation (both the official and pedagogical recontextualisation fields) to extend possibilities for workers to learn more about economic potentials and access routes into more sustainable jobs. It identified the need for a more systemic approach to waste management in rural areas, improved compliance and also to model better waste management practices to avoid performative contradictions between the knowledge promoted in the field of production and the official and pedagogical recontextualising fields and the field of reproduction, where workers are learning this knowledge via a mix of accredited training and exposure to participation in waste management practices.

The contribution of this study to new knowledge is that it offers an epistemically grounded and theorised pedagogical process model for Level 2 Waste Management Training (in the EPWP programmes, but potentially also more broadly) (see Figure 8.3) that accords with the need for a strong epistemic relation code (ER+) embodied in the need for learning scientific and technical waste management knowledge and procedures, while also addressing workers' needs for greater epistemic access and participation in knowledge building and application of waste management knowledge in praxis as per the purpose of the EPWP training programmes, thereby potentially opening up more sustainable learning pathways for them out of poverty and the EPWP training opportunities.

The study has pointed to key areas for further research, including further research on the proposed model, further research into Level 2 pedagogical practices and further research into the foundations of waste management learning in schools, as most of the workers who were participating in the training in the EPWP programmes were educated at above Level 2 before participating in the projects, yet their knowledge and experience of waste management was mostly based on everyday knowledge, pointing to an absence of adequate waste management education in schools in rural contexts in South Africa.

The study has also made various recommendations for improving waste management education and training at Level 2 in EPWP programmes in rural areas in particular (but potentially also more widely), notably the need to develop a more inclusive knowledge framework that includes historical and economic knowledge more explicitly at all levels of the recontextualisation process; improved pedagogical and assessment practices that take better account of learners knowledge and experiences in knowledge building processes; and giving attention to structural and systemic approaches to waste management in rural areas to avoid performative contradictions that arise between the knowledge being promoted in the field of production and the field of reproduction and the actual context of waste management. It is hoped that workers in the EPWP programmes will ultimately be the beneficiaries of the knowledge produced in this thesis.

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APPENDICES

APPENDIX 1 : QUESTIONNAIRE FOR WASTE MANAGEMENT OFFICIALS

BACKGROUND QUESTIONS

Gender:

Qualification in waste management:

Highest Qualification:

Years of experience in waste management**:**----------

How did you choose to be an official in waste management?

Why did you choose to be an official in waste management?

In which field/ discipline of specialisation were you trained?

Is it belonging to the natural Science subjects?

Yes/ No

If it belongs to others, which ones----------

Is belonging to the Human Sciences?

Yes/ No

Is it multidisciplinary?

Yes/ No

Is it a combination of theory and practice?

Yes/ No
Other and explain ----------

What types of previous experience do you think workers need to engage in, in order to qualify in waste management training?

What should wastepickers know (Content in WM) for them to do their waste management work better?

As a specialist in waste Management, which knowledge/ content would you consider for inclusion in a waste management course for matriculants working in a municipality

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Is waste management offered as a field on its own / as a subfield of another field in tertiary institutions?

YES/ NO

If offered as a sub-field, in which field does it belong e.g. (environmental science, geography?)

In which type of institutions is it offered in SA?

Universities

YES/ No

Universities of Technology

YES/ No

Technical Colleges

YES/ N0

In which departments / disciplines is it offered?

Is it offered as a course with a number of modules?

Is it a module within a course?

In your opinion how important are the following for one to be good in Waste Management?

	Not all important at all	Not very important	Quite important	Very important
Skills				
Techniques				
Specialist knowledge				
Waste Management legislations				
Natural-born talent				
Taste				
An ability to make judgements				
A love for it				
A lot of practice				
To read a lot from books				
Learning from other people				

APPENDIX 2: Transcript of Questionnaires sent to officials working in the field of Waste management

BIOGRAPHICAL DATA from Questionnaires sent to Waste Management Officials								
Name	Gender	Years of experience in the field	Qualification in WM	Highest qualification	How did you choose to work with WM	Why did you choose	Is it a natural/ human science	Speciality in WM
Desmond	Male	8yrs	Diploma in environmental Engineering (2)	MBA	My interest in applying chemistry in WM particularly hazardous waste influenced me	Availability of job opportunities	Natural	Chemistry (I have a BSc in Chemistry); Meteorology /Weather Forecasting (I have a BSc Hons in Meteorology); and Environmental Engineering (Have Graduate Diploma in Environmental Engineering)
Eric	Male	11	Bachelor in Environmental sciences (1)	Bachelors degree	love clean and healthy environment opportunities in the field of WM	To assist the communities with waste management issues raise environment and waste awareness to the communities since WM is a serious challenge in our country.	Natural	Pollution Waste Management and Environmental Impact Assessment

Khalo	Female	7.5 yrs	Masters Degree in Environmental management	Master in Env. Management	lt is because of my studies in EM and WM is one of the key careers within EM	It is very interesting and covers all sectors of the economy. The impacts of bad waste management can be severe and will be felt by generations.	Natural	Regulations and Policy in Waste management
Shalo	female	14yrs	Environmental Engineering	MSc	Applied for vacancy in waste management section	It was the position that was available for me to apply for and I fortunately got successful and was employed.	Natural	Environmental Engineering
Tshilo	female	15	Masters in Environmental Management	Masters in environmental Management	No answer	Because I wanted to make sure that I contribute to beautifying the country through development of policies	Natural	Environmental management
Tembie	Female	10	I have it as part of other qualifications and have	Masters in environment and society	Started with an assignment on an environmental	found it very interesting and there was need to share what I		Environmental Science and education

			attended short courses		education course. Then I got interested and learnt more.	knew while I also learnt more about waste management		
Sister A	Female	12yrs	Did waste Management as a course as part of my Honours degree	MSc. Environmental Science	I did some work on a part time basis while studying towards my Masters degree for a consulting firm which specialises on waste and they offered me a permanent job after completion of my studies.	As I learned about waste management, I realised that it was very interesting and had more to it than what I initially thought. The science behind it fascinated me as I did not think of it as a scientific filed.	Natural Science	Environmental Science with a focus on water quality. The course was theory based as well as practical although limited. This could be due to the course structure not necessarily the discipline

1.Qualifications of the waste management officials are mostly from the natural sciences. They are inclusive of environmental Engineering, Environmental Sciences, Environmental Management, Environmental Health and pure science (MSC). They have specialised in different specialities namely Chemistry, Meteorology, Environmental Engineering, Pollution, waste management and environmental impact assessments, regulations and policy in waste management, Civil engineering, and Chemical engineering. They say that waste management is not offered as a field by itself it is offered as subfield / module in the environmental qualifications listed above. They concur that WM is offered by both universities and technikons. Some have done waste management as a module but others had done pure science majoring in chemistry and physics. They were just fortunate to be engaged in opportunities in waste management, saw posts advertised, applied and managed to get the jobs. They found their chemistry expertise useful to understand the pollution emanating from various chemicals.

(Have Graduate Diploma in Environmental Engineering)

	Continuation of the information from Questionnaires sent to Waste Management Officials							
Name	Disciplines in which it is offered	Institutions in which it is offered	Past experience workers need to engage in to qualify in WM	What wastepickers/ collectors need to know (Content in WM) to work better?	Content you consider important for inclusion in a WM course prepared for matriculants working in municipalities	Is it Field/ subfield	If subfield of which field	Excess information
Derrick	Subjects in waste management get offered from environmental science, environmental engineering Civil engineering, even Chemical engineering	Universities & Technikons	A background in chemistry is vital. Waste characterisation and classification is based on the chemical composition of waste	Difference between hazardous and general waste; knowledge of recyclable waste streams; knowledge of danger associated with certain waste streams	Waste classification; contribution of the waste sector in the green economy; basic waste management practices or approaches; Basic landfill operations; waste and climate change	some Universities having a module or a course in Waste Management amongst other subjects offered in Environmental Management	Natural	two universities will be offering degrees in Waste Management (Waste management Engineering) as from next year. These are North West University and KZN university.
Errol	Environment, agriculture, Geography and natural science as a module	Technikons & Universities	Environmental Health, Environmental education, Environmental experience	Health and Safety issues Different types of waste (separation of waste) Cause of Litter	WM awareness is key in achieving best practice in waste management, people should know why they should not litter. Be told about the benefits for	Subfield.	Environmental Sciences and Environmental Management	Pollution Waste Management and Environmental Impact Assessment

	within a course			Value of Waste/recyclable The benefit of living in a clean and healthy environment Should know how to conduct awareness to the community Health and Safety issues Different types of waste (separation of waste) Cause of Litter Value of Waste/recyclable The benefit of living in a clean and healthy environment Should know how to conduct awareness to the community	better waste management			
Khash	Environmental Science	Universities & technikons	Generally environmental management and natural sciences. Other field include chemical engineering where they can understand the pollution	Dangers and Impacts of different waste streams. The handling of certain hazardous wastes can have health impacts	Integrated Waste Management, understanding the whole lifecycle of waste from generation to management (recycling, treatment, disposal). I would also want them to understand the economic benefits which can be derived	It is mostly offered as a sub-field. I know that University of North West was trying to have an Honours Degree in	subfield	Regulations and Policy in Waste management

			emanating from various chemicals		from proper waste management.	Waste Management.		
Sharo	Environmental science/ Business Management Environmental Engineering	Universities and technikons It is a module within a course,	Understand the basics of environmental management/ science	What is waste and its value Waste management hierarchy Waste segregation (separation at source) and its importance Importance or Value of recycling vs disposal Waste management options (treatment technologies)	Waste collection – how it works (quantities collected/ disposed/ recycled) Waste separation at household level- benefits Implementation of the waste management hierarchy Recyclables – how much is collected and what happens to it Where can the recyclables be taken? What are the recycling facilities in the municipality	Subfield / at post graduate level	I am aware that waste management if offered at post graduate level at some institutions but in most institutions it is included a sub-field.	
Tshili	Environmental Health and environmental management	Universities and technikons	General environmental training	Classification and dangers of waste management	Legislative requirements and -------- Classification	subfield	Environmental Management	Environmental management
Tembsie	Environmental Science & environment	Universities and universities of technology	Household waste management, industrial waste management and hazardous waste	• Waste hierarchy • Types of waste	• Waste regulation • Roles and responsibilities	Subfield	Environmental Management &	

	al management		management – depending on the work they do • Types of waste • Management options Health and safety measures • Beneficiation of waste	• Appropriate containment • Appropriate storage/transport • Appropriate disposal	• Waste options/technologies		Environmental Science As a module	
Afrika	Environmental Sciences	University of Kwazulu-Natal University of Free State used to have a guest lecturer (don't know if it is still happening. Potchef stroom university is working on a Post	It depends on the aspect of waste management they are going to deal with. If is it administrative then they would need administrative, but if for example its landfill management, they may need engineering skills. Again it really depends on the job level as well as the landfill size and class.	I think waste pickers know what they need to know on waste management for the purpose of what they do. They know which streams fetch good prices and where or how to get them. What they need to know maybe health and safety issues as well as business skills.	It depends on what it is they will be doing. However, one thing that all of them need is the legal framework on waste specifically what is expected from municipalities or the legal obligations of municipalities. The other contend will be based on their specific job	As a course as part of specific degree although it differs from university to university.	Differs from university to university, but where I. Is it offered as a course with a number of modules? The ones I know are courses as part of a degree. With the exception of Potchefstroom as	studied it fell under Environmental Sciences

		Graduate programme for waste management. Universities					explained above	

	Continuation of the information from Questionnaires sent to Waste Management Officials							
Name	Derrick	Erol	Khash	Sharo	Tshili	Tembsie	Afrika	Excess information
Skill	Quite important	Not very important	Very important	**Quite important**	No answer	**Quite important**	I therefore cannot fill the table below.	there are different work opportunities and levels within waste and as such different requirements. E.g. to be a waste collector one does not need any formal education, but if they have to manage landfill sites, they do need a science background. However this also differs from municipality to municipality as the waste issues become more complex with increased population. I therefore cannot fill the table below. Afrika's explanation
Techniques	Very important	Quite important	Quite Important	Very important	No answer	Very important		
Specialist knowledge	Quite important	Not very important	Quite important	Quite important				

					Very important	Quite important		
WM-legislations	Quite important	Very important	Quite important	very important	Very important	Very important		
Natural-born Talent	Not very important	Not important at all	Not very important	Not important at all	No answer	Not very important		
Taste	Not important at all	Not important at all	Not very important	Not important at all	No answer	Not sure		
An ability to make judgements	Quiet important	Not very important	Very important	Not very important	No answer	Very important		
A love of it	Quiet important	Very important	Very important	Not very important	Very important	Very important		
A lot of practise	Quiet important	Not very important	Very important	Quite important	No answer	Very important		
Read a lot from books	Quiet important	Not very important	Very important	Very important	No answer	Quite important		
Learning from other people	Quiet important	Quite important	Very important	Very important	No answer	Quite important		

1.All the interviewed officials agree that specialist knowledge is very important in waste management.

2, All the officials agreed that Skills and techniques are very important in waste management

3. All officials agreed that Waste management legislations are very important in waste management

4. All agreed that reading a lot from books is very important for waste management

5. They all agreed that the ability to learn from other people is very important in waste management.

6. 5 out of six officials agreed that the love of working with waste is important for officials in waste management

7, 4 out of six officials officials agreed that work in Waste management needs a lot of practise

8. They agreed that talent is not important at all for waste management

9. An ability to make judgements is not important for waste management.

10.there are different work opportunities and levels within waste and as such different requirements. E.g. to be a waste collector one does not need any formal education, but if they have to manage landfill sites, they do need a science background. However this also differs from municipality to municipality as the waste issues become more complex with increased population. I therefore cannot fill the table below.

Afrika's explanation

Table: Responses of DEA officials to the Part 3 of the questionnaire

Name	Desmond	Eric	Khalo	Sharo	Tembi
Skill	Quite important	Notvery important	Very important	**Quite important**	**Quite important**
Techniques	Very important	Quite important	Quite Important	Very important	Very important
Specialist knowledge	Quite important	Not very important	Quite important	Quite important	Quite important
WM- legislations	Quite important	Very important	Quite important	very important	Very important
Natural-born Talent	Not very important	Not important at all	Not very important	Not important at all	Not very important
Taste	Not important at all	Not important at all	Not very important	Not important at all	Not sure

An ability to make judgements	Quiet important	Not very important	Very important	Not very important	Very important
A love of it	Quiet important	Very important	Very important	Not very important	Very important
A lot of practise	Quiet important	Not very important	Very important	Quite important	Very important
Read a lot from books	Quiet important	Not very important	Very important	Very important	Quite important
Learning from other people	Quiet important	Quite important	Very important	Very important	Quite important

Two of the respondents were disqualified as they did not answer this question

APPENDIX 3a Transcripts of the interviews conducted after 7 months in Project 1

BIOGRAPHICAL DATA FOR WORKERS INTERVIEWED IN PROJECT 1 IN EC							
Name	**Gender**	**Rural/urban**	**Level of education**	**Last School attended**	**School zone (R/U**	Previous job	Present Job
Cawekazi	Female	Rural	Grade 12	Zwelihle SSS	Rural	Cleaning in Ntsika- Yethu Municipality for 3 months	Litter-picking & street cleaning
Siphokazi	Male	Rural	Grade 12	Dinizulu SSS	Rural	None	Litter-picking & street cleaning
Love	Male	Rural	Grade 12	Nqabisile SSS	Rural	Worked as a cleaner in Pelopepa Health Train	Litter-picking & street cleaning
Zuko	Male	Rural	Grade 12	Nqabisile SSS	Rural	Cleaned the aeroplanes- in Cape Town	Litter-picking & street cleaning
Nompakamo	Female	Rural	Grade 8	Kholobhisi	Rural	Worked in the municipality for 3 months – cleaning waste	Litter-picking & street cleaning
Sindi	Female	Rural	Grade 11	Dinizulu SSS	Rural	Worked in Bernett furniture Shop	Litter-picking & street cleaning

Interviews after 7 months

Case 1. Cawekazi

What have you learned through participation in the project: 8 Question: As you have been in the project for seven months now can you share with us what you have learnt about the cleaning and management of waste during your participation in the project?

Answer: we do not burn waste. In town we collect and send the waste to the landfill site. In the tip there are people that are separating the waste; cardboard, glass bottles, plastic bottles. There are trucks which come and collect the separated waste. They are written Chola Konke. Learnt that waste can be reused, and recycled. This practise bring an improvement in the lives of the people. Waste can be collected, sold and then recycled. That brings an improvement in the lives of the people. The people have learned cleanliness. Answer: I Have learnt that people have different personalities others clean and others do not. Others put the waste where it is supposed to be put in cages while others throw it outside the cage. I think the businesses in town need to be taught on how to manage their waste. When we go away during weekends and holidays we find the town more filthy. Question :What do you think can be done? There is a need to make sure that there are people working and cleaning towns always.

Case 3: Love

Interview after 7 months:

Question: As you have been in the project for seven months, can you share with us what you have learnt about the cleaning and management of waste during your participation in the project? I have learnt the how to manage the soil, and prevent the erosion of the soil. How do you prevent soil erosion? –We plant the grass and the trees. We have learnt that waste need not be burnt amongst or in the vicinity of the people. Waste need to be collected put in plastics and sent to the tip. In the tip there are people and trucks from Chola Konke. They have big bags. They separate the waste in the tip- landfill sites; bottles only, plastics, plastic containers. Learnt that some of the waste can be reused and people can make money out of it. What do you think will be the condition of the town when the project has come to an end : I think it will return to the original state of being dirty. Have learnt about the behaviours of people: In town there are cages, bins but people do not throw in bins and cages. When we go away during weekends and holidays we find the town more filthy. Question :What do you think can be done? There is a need to speak to people and create awareness in the businesses in town on how they need to deal with waste.

Case 4: Happy
Left the project, not there after 7 months

Case 5: Andisiwe
Left the project, not there after 7 months.

Case 6 : Sindi
After 7 months:
Question: As you have been in the project for seven months now can you share with us what you have learnt about the cleaning and management of waste during your participation in the project? I have learnt that waste need to be separated cardboard, paper, tins and bottles. Why? They can be used again; They can do another work; Waste can be used in a lot of other projects. It can be recycled. What do you think will be the condition of the town when the project has come to an end : It will be dirty. The people do not listen they throw wherever they besides the effort by workers to make them aware. What do you think can be done? There should be guards in town who when they see people littering would.

Substitute 1: Siphokazi: Is a female. She has been in the project for 7 months.
Waste should be removed amongst people. It causes diseases.
Cleanliness brings good health. Learnt how to clean the dumps. We clean them and cover those areas with crushed stone
Trees and grass should be planted to prevent soil erosion.
At the landfill site there are people who separate the waste. (paper, cardboard and bottles both plastic and glass bottles and tins).
People in town throw paper on the floor even when there are facilities for them to put them in e.g. bins and cages.

Substitute 2: Zuko
I have learnt that waste can be used again e.g plastic containers .
We need not burn the waste – the smoke causes the pollution of the air. Because of that we do not get rain there is drought (concept of climate change).
Waste can benefit the people. In Idutywa there are people who benefit from waste _ Chola konke. They separate the plastics. They take plastics and develop different artefacts waste mats and clothes. We develop other glass out of glass. Tins are recycled . Bottles can be used to produce other bottles while tins can be used to produce other tins.

Just on the Easter week end we were not working. When we come to work on Monday we find the town dirty . The people have created another illegal dump. They is dumping next to the ranks.. They throw next to them instead of throwing in bins.
Question : What do you think can be done?
Need to be taught what to do with waste as there are cages but they do not use them. Need to be taught door to door .
Businesses in towns need to be educated.
Hawkers open the black bags when they have already closed the bags and take out whatever they want. Cause the cleaners to redo what they have already done.

Substitute 3: Nompakamo
We have learnt that there are things that need not to be done. We need not burn waste.
We neeed to collect it, put it into plastics, into cages and then put into trucks and send to landfill sites.
Chola Konke is helping to separate the waste and take it away by trucks.
When we go on holiday we find the filth in town worse. Hawkers, businesses and households are making the town dirty.
P1/W4/5 From my observation It is only municipal officials who are interested in the cleaning and beautification of the town. They give them plastics but the plastics and put them outside the cages.

APPENDIX 3b: Transcripts of the interviews conducted after 7 months participation in the Project – Project 2

BIOGRAPHICAL DATA FOR WORKERS INTERVIEWED IN PROJECT 2 in EC							
Name	Gender	Rural/ urban	Level of education	Last School attended	School zone (R/U	Previous job	Present Job
Abongi	Male	Rural	Grade 9	Tabankulu high school	Urban	Cleaning, scrubbing and braiing meat in MAX in Durban	Litter-picking & street cleaning
khaya	Male	Rural	Tertiary institution /	Walter Sisulu : Butterworth	Urban	Intern Department of Education	Litter-picking & street cleaning
lizo	Male	Rural	Grade 8	Manzana – Mt Ayliff	Rural	Security	Litter-picking & street cleaning
Mfana	Male	Rural	Grade 11	Mnceba	Rural	Building and motor- mechanic in Mpumalanga	Litter-picking & street cleaning
Sanda	Female	Rural	Grade 11	Sophumelela - Cape town	Rural	Removing paint on old cars – it was a three weeks contract job	Litter-picking & street cleaning
Bongi	Male	Rural	Course 1 :Building Engineering	Border Technikon	Urban	Insurance Agent	Litter-picking & street cleaning

Case 1: Abongi

After 7 months:

Question: As you have been in the project for seven months now can you share with us what you have learnt about the cleaning and management of waste during your participation in the project?

Answer: I have learnt the importance of planting trees in an environment. The use of the different environmental resources in the development of a park for example the stones, the grass and the different types of grass out there. We were also taught how to prepare the soil. Answers: We were taught not to throw grass away. We need to remove the grass and put it back in the soil, it will decompose and create manure. Question: Why do you plant trees? Answer: for creating shadows and for getting clean air.

Case 2: Khaya

After 7 months : Main Question: As you have been in the project for seven months now can you share with us what you have learnt about the cleaning and management of waste during your participation in the project?

Answer: I have learnt the importance of or why it is important to manage waste in town and ways of managing it. A person need not throw waste anywhere. When dealing with waste the people and the environment should be taken into consideration. We are taught not to burn waste as the smoke is dangerous to the people. One can create a business out of waste. One can collect the bottles and sell them. Answers: It is important the places where people live clean. Waste is collected and taken to the landfill site. Question is there anything more you do with the waste? Answer: No other things we do

with waste here. But, in the tip there are people from the surrounding areas. They collect the bottles and the tins. They sell the empty bottles to the shops. They collect tins to do recycling

Question: What do you think will be the condition of the town when the project has come to an end. Answer: I think it will return to the original state of being dirty Question: Why? Answer: We have been home for Easter when we came back we found the town dirty. As the people are throwing almost everywhere On weekends we do not work, on Monday we get the town dirty. Question :What do you think can be done? The Municipality need to create awareness in the businesses in town on how they need to deal with waste.

Case 3: Lizo

After 7 months

Question: As you have been in the project for seven months now can you share with us what you have learnt about the cleaning and management of waste during your participation in the project? A: I have learnt the type of soils. How to prepare the soil. Taught the names of plants. I learned how to make a park. How? We remove the waste, We dig, we plant vegetation. We make footpaths. Question: Of what use is the park. It is for recreation. That is where the people spend their free time. It is also for beautification. Answer: We replant the grass in the park.

Case 4: Mfana

Interviews after 7 months:

Question: As you have been in the project for seven months now can you share with us what you have learnt about the cleaning and management of waste during your participation in the project? Answer: I have learnt that there are useful things that we can utilise in waste. We can collect bottles and tins and recycle them. Bottles can be used to produce other bottles while tins can be used to produce other tins. Answer : We can form groups or I can do it alone. We can separate the waste and prepare it for recycling. Question: How do you deal with the waste at the moment? We collect, put it in black bags and throw it in the municipal trucks. We sweep the streets, take the soil and close the ditches in town with it. We remove the soil as it causes the blockages of drains. Question: Who are the most polluters in town? Answer: The businesses especially the Chinese shops. We cannot talk to them as they know no English.

Question: What do you think will be the condition of the town when the project has come to an end : Answer: I think it will return to the original state of being dirty. Question: Why? Answer: On week ends we are not working. When we come to work on Monday we find the town dirty. The people in town are not using the prepared facilities like bins. They throw next to them instead of throwing in bins. Question :What do you think can be done? The Municipality need to create awareness in the businesses in town on how they need to deal with waste.

Case 5 : Sanda

Interviews after 7months

Question: As you have been in the project for seven months now can you share with us what you have learnt about the cleaning and management of waste during your participation in the project?

Answer: I have learnt the importance of planting trees in an environment. We plant trees and sheer the grass. We make compost. We need not throw the grass away. We replant it in the park. We learnt how to make compost. We dig put in the grass and cover it with soil and plant over it. How to use manure when we plant trees. How to collect different types of plants and plant them. We collected the waste and put it in plastics. We do not mix grass and tins. We keep some of the tins and use them for drinking water.

Case 6. Bongi

After 7 months

We have learnt how to clean the town. The workers need to come to work very early and clean the town before the Tourists get into town. Need to pick up the papers and clean the bins early in the morning and put the town in order.

How to manage the waste and dispose it.

Pick, sort, put it in black bags and put it together for the truck to come and collect.

But in one of the months we experienced a problem of the skip bins. The municipality brought these bins. They are quite tall. They are not user friendly. The people dispose the waste outside the skip bins and the municipality keep them until they are too full.

Need not burn the waste as the burning contaminates the air.

We need to separate the waste.

We need facilities to measure and recycle the waste.

Things learnt in the development of the parks:

Learnt that they can use the ordinary, natural resources for beautification. We need not buy things, we can take what is available e,g stones, different types of grass , aloes to beautify and different types of indigenous tree. The trees can bring different types of birds into town.

We can collect the decomposed materials within the area and use them as manure. And also develop our own composting facilities

We can create cooperatives or businesses which can assist to keep and maintain these facilities moving forward.

Learned that the environment needs to be conserved

From my observation it is only municipal officials who are interested in the cleaning and beautification of the town.

The general workers who are supposed to clean the town are not interested in the activities of the project. They are the people who are supposed to maintain this town moving forward. While we work they are not interested in what we do.

APPENDIX 4: Transcript for the training in Waste Management by Provider 1:

Facilitator: XXX

Introduction

What is waste management and what is waste?

Facilitator: The whole world today is struggling with the problems of waste management.

It is important for us also to understand waste management systems to ensure that the level of waste in the world is decreased with its effects on the environment. As we move forward there will be a lot of new terms. You need to write then down so that you develop a dictionary for waste management terms as we move forward. I shall explain some but others you will have to look for them in the English dictionary for you to understand what they mean. If I speak deep English please tell me and if you do not understand please talk.

Waste is divided into 2 different types namely natural waste and human waste. Natural waste develops naturally from living organisms for example to sweat, decomposition. When a dog dies it decomposes and goes back to nature naturally. We shall discuss types of waste and the categories of waste. One needs to link these concepts as we move forward.

We humans there is additional waste that we accumulate. We humans changed our lifestyles. Long ago people were living a simple life. They were staying in houses made up of grass. People were close to nature and the environment. There was not a lot of waste.

New civilization came in and there was a move from this type of living to modern ways of living. Factories were established. Factories deposited their waste into the rivers and seas. The ships moving across the seas from different continents in the world deposited their waste in the water. The people were more concerned about the money and production than the earth. All the conveniences they enjoyed impacted on the environment. That is why we are experiencing a problem of waste.

The neglect humans had on the earth impacted on the environment, for example, If I throw away this pen. It is not the only waste from the koki – pen. There are other elements which were put together in the factory in order to come up with a product which is a pen. Throughout those entire processes there are waste products which were produced.

Waste does not commence at the level of government, It starts with everyone of us in our own households. Whenever you are whatever you do need not impact on the environment. As we impacted on the environment and produced waste we caused imbalances in the environment and now mother earth is fighting back. Mother earth is trying to fight the imbalances in the world. That is why today we hear of tsunami, climate change and snow falling during the Summer months in South Africa. All the things are influenced by our practices which are detrimental to man and the environment. That it is why all over the world the people are concerned about waste and its impacts on the environment. Laws have been set which regulate how waste should be managed.

UNIT 1

Facilitator : Opens the POP. Please open your pops on formative assessment (question) in page 37. The one in the beginning of page 37.Do we all see it

Students: Yes

Facilitator : The question says" discuss what is pollution" Unit one therefore deals with the answer to this question. There are 3 types of pollution. In your file after we have discussed the types of pollution you will discuss and answer this question. As you answer the question you need to give examples from your communities.

Facilitator continues with the lesson:

Pollution is caused by waste. When there is too much waste there is too much pollution. Pollution is the result of waste.

Defines air Pollution:

Is the accumulation in the atmosphere of substances that in sufficient concentrations, endanger human health or produce other measured effects on living matter and other materials. When something is classified as pollution the level of the concentration of substances in the air is measured. For example there is the difference in the level of accumulation for a braai that from the chimneys . The accumulation of substances from chimneys of factories is very high and therefore can be classified as air pollution. For a substance in the air to be classified as pollution it needs to be highly concentrated. iBraai as compared with factories is not concentrated.

Characteristics of pollution,

It should be measurable. It should endanger human health or the ecosystem. E.g. if the company pollutes it should pay for its pollution and how it affects the human health.

It is generated from power emissions, for example Soweto in Winter is covered with a smog

Do you know what the smog is?

Students- No answer

Facilitator: the smog is the black smoke which covers the whole of Soweto in the mornings and afternoons. I do not know if it is still there. The people of Soweto were used to be using coal stoves for fuel. The home owners were buying coal and every house was making coal fires in the mornings and afternoons, The smoke from those fires was causing the pollution of the air.

Other causes of air pollution are burning of solid waste, industrial processes and transportation. The roads are always full of cars and the people are not sharing transport, they are travelling one by one in their cars. There is a lot of traffic. The exhausts of the cars produces emissions. That is why petrol was changed from leaded to unleaded. To decrease the emissions a lot of things have been changes.

The fridges have been changed to ordinary fridges to CFC fridges. Even the ladies and cleaning sprays today contain CFCs to prevent the pollution of the air. Our lifestyles impact on the environment that is why we need to be aware.

Land Pollution

Land pollution is about the degradation of the land. Underline degradation. What does degradation mean? Degradation is when you spoil something and lowering its value. This one is happening on land and in the soil. This time our lifestyles impact on the soil through agriculture. The farmers want

to get money out of their produce. They therefore use pesticides which degrade the soil the soil. When the rains come the pesticides are carried by water into the rivers.

But there is another alternative. People today talk about organic farming. Is there anyone who knows organic farming?

Students: No answer

Facilitator: Organic farming is the growing of plants in a natural way without the use of pesticides and fertilisers. If you are a stock farmer, one grows his stock without using genetically modified plants foods and medicines. When we use genetic modified substances the consequences are that they impact on our health. The basic issue of waste management is to make us aware that we are responsible for our lives and everything we do has an impact on ourselves and the environment. Another cause of land degradation are mineral exploitation and waste disposal.

Water pollution: Is caused by the introduction of chemical physical or biological material into the water systems that degrade the quality of the water and have an effect on the organisms that live in it. For example when the animals are dead they are deposited by waters into the rivers. They effect on the ecosystem. The ecosystem is a community living organisms in the river . As we as people are having our communities. The river community includes fishes, tadpoles and microbes. When a chemical is introduced into this community, it destroys and kills the members of the water community. The examples of the water pollutants are dissolved or suspended solids, pesticides, heavy metals and non-biodegradable and bio-accumulative chemical compounds.

Facilitator: How do these things get to the water?

Learner: They are washed by the rains into the water sources.

Facilitator: Now it is time for group work. Turn to page 37 of your formative assessment book.

Discuss the 3 types of pollution. Bring up your own examples of pollution from your communities

Do not use the ones I have discussed with you and the one in the learners' guide.

Write your deliberation on the sheet of paper

Each group will nominate a person to come and report in front.

Facilitator distributes the sheets of paper and Koki pens

Group 1	Group 2
Air Pollution: In our groped we looked at examples in our communities. The people put their waste in dustbins. When they are full we take them out and burn The smoke comes out and spoils the air. Digging of the soil using machinery. Roadworks, power station and digging of crushed stone for construction	In our area the landfill site is situated not far from the Black residential area. There are few recyclers and they recycle only cardboard an bottles. Other recyclables are not recycled, they are burnt. The smoke comes out and disturbs the nearby areas. A smog develops and is detrimental to the environment and the nearby schools and residential areas.

Veld burning contributes to smoke /smog in the air Dead animals pollutes the atmosphere with bad odours	Effluent of factories Tyres small businesses next to road burn their tyres and spoils the air. Veld burning affects the air. We loose our animals because of choking
Land Pollution Mineral exploitation : they dig and spoil the land crushed , stone, toilets ant Eskom poles. Degrade the soil by causing dongas and soil erosion Manual digging and utilisation of homemade sewage systems as the people do not have machinery. Their activities spoil both the land and the air.	**Land Pollution** Waste spoils the land. It becomes a dumping site' Moisture and water make the place unusable. Children develop rash and sores Big trucks carrying hazardous materials are involved in accidents. The oils spoil the grass and the road. The spills burn the grass while the spills cause more accidents.
Water pollution	**Water pollution**
Swimming, drinking and doing of washing on the same river	Litter flies to the rivers and spoil the water
Dead animals are washed by rain water into the river systems	Chemical used by people in gardens . They utilise them to increase their produce for commercial purposes but they are detrimental to their health.
The ecosystem are destroyed – animals, and microbes	After the rains/ during the rainy season the water deposits /washes away the chemicals in the fields into the river systems.
Cars are washed in the same river- their oil spills spoils the water	Ecosystems are spoilt by the chemicals. On the flat lands on the run –off create furrows and which lead to the rivers and end up polluting the ecosystem.

Questions: What happens to the flat areas, Is their water also channelled to the fields?

Answer: It depends on the topography of the soil

Question: what happens to the chemicals ? Do they loose their strength enroute to the river systems

Answer: It also depends on the type of chemical; Most of the chemicals are not biodegradable and so they keep their structural elements.

Facilitator: So I liked this debate it was healthy. We discussed various types of waste and the categories.

Categories of waste

Facilitator: We are now moving on. We shall now discuss the categories

There are 3 categories of waste namely:

Primary waste

Secondary waste

Precursor waste

F : Question: When talking about primary waste what are we talking about ?

Students: No answer

F: what is primary school

L: The first levels (izinga lokuqala)

F: Primary waste is waste produced from source; Can you please give examples of primary waste?

Students: fumes from cars, animal waste from abattoirs

F: What are we human beings producing as primary waste?

S: Faeces and urine

F : Secondary waste : This is produced when primary wastes react with each other and other substances e.g. waste site mixing producing more toxic volatile compounds.

F: Precursor Waste : It is formed when waste gases react in the air to form other pollutants

Waste is being present in all the environments. She showed them a picture of a child surrounded by waste. Explained the scenario.

This is happening in the sea in India. The child is fishing. The sea is full of litter. When it rained the waves collected all the waste from the land, and it has developed into a waste island. How are the fishes below that cloud of waste. 70% of that waste comes from the land.

Made an example of the fridges which were thrown into the sea. Used to have mercury. Fishes would eat the mercury and the people would eat the fish. They would get sick. Everything we do impact on us and the environment.

Ground Waste:

F: What is ground waste?

L: I think ground waste are illegal dumps,

F: Ground waste is waste that is legally or illegally stored in the ground. Waste used to be hidden on the ground and it would leak and spoil the ground. Examples are toilet pits, Dirt in landfills after they have be closed for some time.

Water waste: Waste growing in our water systems examples are raw sewage and treated sewage, outflow water from treatment works.

Air waste: The atmosphere acts as the disposal facility for the whole world. Co2 and other million gases are deposited into the atmosphere. Methane is also deposited in the air. It causes the depletion of the ozone layer which exposes us to the dangerous rays of the sun which cause skin cancer. Methane is produced through natural processes. Even when the animals die they decompose and release methane into the atmosphere.

Commercial waste/ domestic waste

F : What do we produce at home ?

S : egg shells, bread crumbs, peels of vegetables, food remnants

F: All these are biodegradable, can you give other examples which are non-biodegradable. What do you use for cleaning?

S: plastics, soaps, polishes, sprays

F: They also form domestic waste.

F – Industrial waste – waste produced by industries.

Construction waste – examples: concrete, cement, rubber & dynamite

Agriculture waste: pesticides, fertilizers,

Mining waste:- This waste produced by mining activities. Waste is harmful to the environment.

Electronic waste: computers and cell phones

Hazardous Waste- It is harmful to health. They have the following characteristics:

Infectious – iyasulela

Poisonous – it kills

Radio-active – produces waves

Flammable – can catch fire; can ignite fire

Explosive – can explode

Corrosive _ acidic

Carcinogenic- cancerous

Mutagenic- can affect chromosomes

Teratogenic: causes defects on the unborn

Bio cumulative: Has an ability to accumulate in the bodies of plants and animals

If we pollute the land the land, plants on the same land will be affected, If one eats those products they have an impact on the lives of those who eat them.

Q: Can one please explain to us the cycle of life

S: Egg –chicken- fowl – Cornish – consumers eat ??

F : the facilitator explains. Every ecosystem has got its cycle of life and on top of each there are predators e.g. Where the predator is a lion, when it dies the buffalos and springbok increase and

destroy the vegetation. Everything is there for a reason . Human produced a lot of things which detrimental to the environment and cycle of life.

This the problem which was caused by insecticides, It was discovered that they kill the predators and in the process disturb the life cycle which at the end becomes detrimental to the environment.

ACTIVITY 2 : Give the different types of waste. Activity 2 is on page 38 of the formative assessment.

Describe categories of waste and different types of waste. Give examples from your communities not the ones in the book.

Group 1	**Group 2**
Primary waste	Primary Waste
Provided directly from source	Provided directly from source
Examples: cow dung, minerals, there was a long discussion around a spraying – and a spray as a primary waste	Examples: Waste from animals e.g urine and animal
Secondary waste	Secondary waste
Precursor	Precursor

UNIT 2 : IMPACTS OF POOR WASTE MANAGEMENT, AND PRINCIPLES OF SUSTAINABLE LIVING

F : Poor waste management – no facilities to deal with waste. P14. Waste is not treated it becomes a hazard. Waste has impacts- they are severe on old people young people. Why are they easily affected

L : Their immune system is not strong enough . Look at health impacts individually.

Short term : irritate your eyes, nose, as you are inhaling

Long term: caused when you had constant exposure. It builds up as one is exposed to that: e.g. a smoker. You pollute your lungs constantly and you end up with lung cancer.

Smelly place- that is places with bad odours affects people psychologically.

Noise pollution damage ears. How does it damage them

L: Eardrums explodes

F: no the eardrum does not explode. The ears regulate the noise to the level that it does not hear the noise in order to accommodate the high pitch noises. It ends up having an effect hearing low tones. It also affects the balance. E.g. the miners working in drill in the mines. If unprotected they can loose balance and have accidents. Impacts of water pollution: rash, sores, Bilharzia, cholera and diarrhoea

L: Is cholera not the same thing as diarrhoea

F: Diarrhoea is a symptom of cholera.

Health impacts of Ground pollution:

F: It is caused by toxic substances being spilled on the ground accidentally or by companies dumping toxic waste illegally. When spilled on the ground they affect the plants which are eaten by animals .

They can be, carcinogenic, mutagenic, toxic, poisonous.

Why is waste not always well managed?

Even if the bins available in town you will realise that the people are still throwing the waste around. What is the cause of that?

L: People need to be taught about the environment.

L : They need environmental education on waste

F: But on top of that you will find that even if you educate them the people will still throw. E.g. in Zimbabwe is one of the cleanest towns in Africa. When you are littering in Zimbabwe you are taken to jail. Law enforcement and a functional waste management system are important to prevent waste management. Low population rates also assist.

L: People from other countries come here and increase the population growth . The fewer the numbers of people the less the pollution

F: Regardless of the population if there are no well managed waste management systems pollution will be a problem. Whose responsibility is preventing pollution.

L: No answer

F: There is a belief that waste management is the responsibility of government. Yes I understand in terms of the laws and providing infrastructure but when it comes to individual households it is up to us to protect, prevent and practise good waste management – so it becomes everyone's responsibility.

National Environmental Management Act (NEMA)

This is the act used in South Africa to promote environmental principles. It propagates the protection of the environment from generation to generation.

Principles of the NEMA:

- Cradle to grave- each one is responsible for the management of his/ her waste from the start to the finish. E.g. if one is manufacturing pencil he should be responsible for the waste that comes out as the process unfolds from the start to the end.
- Polluter pays: Whoever is responsible for the waste should pay for prevention and the restoration of the environment if a problem arise e.g. when there has been oil spills in the sea The polluter would need to pay for the cleaning of the penguins and the sea when the oil spills have taken place in the sea.
- Precautionary Principle: It is about making sure that the environment come first. Whenever one needs to implement a project one should start with Environment impact assessment to make sure that there would no impact on the environment

An example : On the daily Dispatch I read about a feud between Mandla Mandela and one of the Mandela brothers.
Mandla wanted to open a mining project along the coast and his cousin wanted to create a reserve. Both of these will create jobs and bring money to the area but the argument was that mining was harmful to the environment while the mining was not harmful. Precautionary measures therefore says we need to take into consideration the precautionary measures environment first.

Need to look at natural and renewable resources and how our lifestyles effect on the resource. We need to protect these resources by reducing, recycling reusing etc. We need to use the environment holistically. What does that mean? We need to take into account all possible avenues - one need to look at the whole than individual parts.

Government need to have lawyers dealing with greater corporate. When they identify loop holes in the legislations they can mass up the environment. Government need to have fines to deal with massing up corporate, need to have someone who have specialised in environmental lawyers or a specialist in environmental law to prosecute the corporate.

All this need to lead towards sustainable living. Underline sustainable living.

When you sustain what are you doing

L: Making sure that something continues.

Roles of Municipalities

At municipal level there are acts dealing with protection of the environment but they need not be contrary to NEMA.

The municipal laws are listed in pg 19

Law	Function of Municipality
NEWA Waste Act (Act 59 of 2008)	Minimising, collecting and disposing of waste
Municipal Structures Act(Act 117 of 1998)	DM integrated development planning, build capacity of local municipalities, equitable distribution of resources inclusive of IDP, Supply of water, electricity, sewage purification, solid waste disposal, municipal roads, municipal health services, fresh produce markets & abattoirs
Municipal systems Act (Act 32 0f 2000)	Give priority to basic needs. Ensure that local municipalities have access to basic needs
National Health Act (Act 61 of 2003)	Water quality monitoring, food control, WM, health surveillance of premises
Public Health bylaws	Public health hazards, sanitary services, sewage works, Water Supply

Municipalities are local government structures, they act as faces of government at the level of service delivery. South Africa has a good constitution. We need to appreciate what south Africa is doing for us as compared to other countries.

The municipalities need to make decisions in consultation with people on the ground.

DAY 2

The Facilitator started by checking the POEs whether work has been done or not.

Commenced with UNIT 3 (page 21)

Waste classification and waste management

Waste is classified into two main categories namely General and hazardous waste.

General waste does not create dander to the environment. It is not harmful to the environment unless it is too much. It is inclusive of domestic, building and demolition waste, inert and commercial waste. It does not create an immediate hazard, unless when it has accumulated,. It may contain also small pieces of toxic waste e.g batteries,

Inert is non- reactive waste e.g. cement; it is used in the storage of hazardous waste.

Hazardous waste cause an immediate threat to the environment. It is:

- Flammable – can create fire
- Corrosive – it eats away
- Toxicological
- Dangerous to human health if not disposed in a proper manner
- Toxic – poisonous and cause harm to the environment e.g asbestos
- Does not biodegrade, harmful to people's health

  Good waste management

  The aim of good waste management is minimise the waste taken to landfill sites. We shall run short of space in the landfill as the communities are growing fast.

  Steps to minimise waste from getting to the landfill.

  1) Avoid generating waste . What does that mean?

  L; We must not come up with waste at all

  F: What can we do at home to avoid waste:

  L: we burn waste

  F: When you burn waste you have already generated it

  L: use plastics to cook steamed bread.

  L: Put sta-soft in two litre coke bottles

  F: The processes you have mentioned are minimising and reusing not avoiding

  L: It seems we cannot avoid waste

  F: we can avoid producing waste: Instead of using plastic bags when going to buy groceries we can use a grocery bag. By using a grocery bag we can avoid using more plastic bags.

  When using rechargeable batteries we can avoid buying more batteries every time-We can just recharge the batteries.

2. Minimise waste by reducing, reusing recovering recycling

Reduce – using different sides of a paper

Tins used to make vases

Recycle – turn waste to something else useful.

Mayonnaise bottles as containers for sugar, tea and coffee.

3. Waste management system of South Africa

It has 8 steps

Part 1: Waste avoidance

- Trying to avoid waste in the first place. It is critical for manufactures to avoid the waste. Avoid creating waste – this needs a mind frame change to take place among individuals and organisations to embrace this e.g having a shopping bag; joining a lift club.
- The idea of waste avoidance links us directly to the 4Rs
- The 4Rs are :-
- Reduce
- Reuse
- Recycle – cannot be done on dirty things, if you recycle dirty things you get less money as they have to hire a person.
- Recover
- Government has made a way of promoting this through alignment with Department of Environmental Affairs and the National Waste Strategy.
- Waste can be reduced by:
- Reducing what we consume
- Reusing items several times
- Recycling those things that cannot be used
- Recovering energy from waste that is burnt, or that rots.

Part 2 : Waste Generation

With all the strategies to try and avoid and minimise waste it is difficult to not to produce any waste at all. By buying groceries we bring home loads of packaging that that which we cannot use,

Vegetables that we shall peel to consume , there will be waste generation no matter how conscientious we are. Following the next steps rigorously can reduce the amounts of waste sent to landfills by phenomenal amounts.

3. **Separation at source: Materials recovery** For:
- **Who generates waste?**
- Us , our homes our households
- We need to separate waste at home at our households

Source can be to the initial source of the waste. – It can be anything from the individual to a family, complex of housing, an office, a factory or even a bin of rubbish. It is the original point at which an accumulation of waste occurs.

Separating at source is important as it simplifies the waste management system. It means a number of things namely:

- Division of waste into categories
- Less time to be spent during sorting when all is put together for sorting
- Sorting of waste to
- what can be recycled and not be recycled

What is recycling ?

It is the process whereby discarded products and materials are reclaimed or recovered, refined or processed and converted into new or different products.

One need to do something on waste which will add value on it

It needs both money and infrastructure support especially in early stages of the initiative for it to be successful and sustainable.

If it needs

Benefits of recycling

It reduces the waste stream going to landfill sites, thus saving landfill airspace

It can create jobs

It helps to reduce pollution and conserve natural resources

It conserves energy and reduces manufacturing costs

It reduces litter

It can reduce informal salvaging from landfill sites

Whose responsibility is to recycle

It is everybody's responsibility to avoid making waste then to reuse, recycle, and repair unwanted items before they are discarded as waste. In that way we won't use up the earth's natural resources like oil, minerals and trees too quickly.

What can be recycled:

Common items which include paper, cardboard, cans, scrap metal, plastic, glass, tyres lubricating oils

Unusual items include motor vehicles , white goods e.g. old fridges and microwaves) electronic products, batteries, and construction and demolition materials.

What cannot be recycled

Dirty recyclable materials

Laminates which are materials made up of mixed layers

Car windscreens

Materials that are uneconomical to recycle because of insufficient volumes or transport distances to markets

Hazardous waste

Recycling in your own home.

F: After these lessons: What will you do to recycle at home?

L1 : I will attend funerals. Request people to clean the bottles of mayonnaise. I will collect them and use them for covering the bulbs

L2: I will collect the mayonnaise bottles and use them as containers for sugar, tea and coffee

L3: will collect old tyres and make shoes out of them

L4:Instead of pampers I shall buy napkins- we shall wash them as pampers are producing a lot of unrecyclable waste

L5: I shall recycle and organise by myself the transportation of recyclables to the recycling company. Last year I had a very bad experience. I collected all the steel utensils in my yard. They were inclusive of the singer sewing machine, my husband's old car engine. The lorries collecting recyclables passed buy my home. For all the recyclables mentioned above they gave me a lousy R5.

I1st step – separate your waste at home into organic waste, plastic, glass cans an

paper. Cardboard and paper are excellent materials for recycling. For every ton of paper recycled 17 trees are saved. It also reduces the amount of air pollution by 74% and water pollution by 35%

Unit 4 : Waste storage collection, and Transport

In this unit we shall learn how to store waste correctly at the source, how to store hazardous waste correctly , and how to collect , load, transport and unload safely and correctly

Storage = safe containerization of waste

Collection= how waste is picked up and loaded

Transport = how waste is moved and off-loaded

Primary and Secondary storage

Primary storage:

Waste is temporarily stored at the place where it is generated. That is it is generated at source.

Examples of primary storage : rubbish bags, drums, bins and wheelie bins

2. Secondary stage

It is when waste is taken from primary

2. Secondary stage

It is when waste is taken from primary storage to and transferred to a larger container e,g a skip to for transport to a waste disposal. Facility or recycling centre. A shop can have would collect waste in a basket and then it be transferred to a secondary storage area.

Storages must be big enough to hold all the refuse generated until a remover removes it. Materials that can be recycled and reused must be identified and must not be thrown away with the rest of the refuse.

Storage of hazardous Waste

It is more harmful to than general waste and needs to be stored in special containers to avoid injury to people or damage to the environment

Table showing examples of the risks or dangers associated with different types of hazardous waste

Types of hazardous Waste	Risk or danger
Health care risk	Spread of infection
Toxic waste	Acute or chronic toxicity Malignancy Mutations or birth defects Ecotoxity
Radio-active waste	Mutations or birth defects Accumulation in biological food webs or persistence in the environment
Flammable waste	Explosion of fires
Pharmaceutical waste	Acute chronic toxicity
Corrosive chemicals	Chemical instability Corrosion Burns of lesions on the skin

Part 5 : Collection and Part 6 : transport

The two above are interlinked.

Different activities that occur in waste a waste collection system are:-

- Primary collection
- Secondary collection
- Loading and transport to a treatment plant or disposal site
- Un loading

Primary collectors carry waste from source such as household to a collection point – where there is a larger waste container such as a skip. Smaller loads are carried by hand while larger loads can be wheeled in a wheel barrow or smart cart.

Secondary collection is done by vehicle

It can vary from a half ton truck to a large mobile compactor truck.

Loading is either done by hand or mechanically

The vehicle transports the waste to a disposal site

Collection and transport of hazardous waste.

APPENDIX 5: Content Knowledge from Research Papers at the level of Production				
No	Researcher	Field	New Knowledge	Year
1	Linda Godfrey, CSIR, Natural resources and the Environment	Natural resources and the Environment	Importance of a waste information system framework for a developing country like South Africa. **Why we need a an information system- for planning, decision making, communication, implementation, monitoring and review** **Data needed in the system** Challenges ranging from strategic waste management at national level , provincial and at local level A shift of government approach to be in line with national and international policy **Roles of National , provincial and national levels** **Nationa**l – Provide strategic leadership and guidance to provinces and local level – develop policies/ legislation/ coordination/ enforcement/ dissemination of information/participation and appeals, monitoring, auditing and review, capacity building and providing guidance. **Provincial**- Implement National strategies, monitoring and enforcement of pollution, waste management issues within their provinces **Local government**- Ensuring provision of waste management services Waste disposal facility management and promotion of a safe and healthy environment, refuse removal, refuse dumps and solid waste disposal **Challenges**: govt is unable to enforce pollution and waste and waste related solutions Not coming out hard on pollutants. Landfill sites in SA are not permitted. To those permitted information exists on their compliance with permit conditions. Non-complying culprit is government itself through municipal landfill sites. Solutions: cooperative governance, accurate waste information, compliance with legislations. Sound strategic planning, budgeting and implementation to ensure, effective service delivery	2008
P2	Council for Scientific & Industrial Research (CSIR)	Waste management global partnerships in on WM	**Identified priority areas as of capacity building**, technical and scientific, financial, policy and regulatory, research and development in landfilling. **To alter the situation regulator, business approaches,**	

			technical solutions, higher financial viability and come up with alternative technologies MSW- regulations are in **place, scope for implementing and enforcing existing policies**. **Development of capacities are needed to enhance the compliance with existing legislation** Technical capacities that ensure successful operation of WM. **Engineered landfill sites. Capacities in auditing and monitoring are required. Majority** of solid waste in SA is still landfilled. **Alternative solutions need to identified e.g- recovery, thermal treatment, beneficiation & recycling**. To operate these there is need for more **support financially.** Capacity building in full cost accounting on WM in municipalities. **A toolkit enabling capacity building in budgeting Increased post-consumer recycling is needed in SA. Capacity programs at household** level is needed to ensure at source **separation, collection, post –consumer recyclable materials** **Capacity building is needed to come up with a well-functioning recycling system**	
P3	Zurbrugg, C. (2003) Dept of water and sanitation in developing countries (Swiss Institute for Environmental science and Technology) Switzerland	Swiss Institute for Environmental science and Technology) Switzerland Presented for scientific committee on problems of the environment	Human activities create waste and it is the way these are handled stored collected and disposed of which can pose risks on the environment and public health. P.1 Municipalities are struggling to even the most basic sevices. Only two thirds of solid waste generated is not collected. Rapid urbanization is taking place in low income contries. In 1985 0nly 41% of the world population lived in urban areas and by 2015 it is projected to to rise to 60%. These agglomerations represent an enormous challenge for environmental services. Slums are growing at alarming rate in the urban poor areaswhere municipal solid waste management services is lacking behind the needs of the inhabitants. Zurbrugg (2003) identified the challenges **experienced by local authorities in Asian cities. He identified them to be inadequate financial resources, lacking management, lack of technical skills in municipalities, insufficient government authorities to**	2003

			deal with the rapid growth of demand of resources, limited budgets, unplanned growth and increasing pressure to provide services, lack of adequate authority to address people, bureaucratic confusion and delays due to multitude of agencies, lacking accountability, limited communication within the city administration and between city administration and various stakeholders, political interference where selected representatives do not confine themselves to strategic planning processes but instead become involved in daily operations, lack of relevant skills of municipal workforces whereby training I s seen as a reward for good work and as a chance to break away from daily obligations.p. 5 PEOPLE CENTRIC CHALLENGES Methods utilised in Asia: Primary waste collection- organised citizens participation in waste collection; Public awareness and attitudes to waste can affect the population willingness to participate in adequate management practices. Resoucesrecovery and recycling activities conducted by the informal sector. Disposal- open dumps still used & observed in developing counties. P.9	
P4	Marshall, R.E & Farahbaksh School of Engineering in the University Guelph Albert A , Thorn Brough Building Canada	School of Engineering in the University Guelph in Canada	Purpose of Solid Waste Management strategies are to address health, environmental, aesthetic, land use, resource and economic concerns associated with the improper disposal of waste. Drivers of solid waste management in high income/ developed countries: Public health-the sanitary evolution; Environment-the modernisation of solid waste management; the resource scarcity and value of waste; climate change; public concern and awareness and Not in my backyard and behaviour change Similarities between historical SWM trajectories of industrialised countries and the current trajectories of developing countries: High levels of urbanisation; degrading sanitary conditions; high levels of morbidity and mortality; social exclusion and inequalities; water disposal and water supply provision.	2013

			Contextual approaches and the challenges they present for SWM systems in developing countries: Urbanization, inequality and economic growth- This has led to rapid unplanned growth and infrastructural challenges.; municipalities are unable to provide SWM services at the rate they are required. There is a growth of urban poverty and national governments are unable to provide services . People are pushed to slums where sanitary conditional are appalling and toilets non-existent. Settlements are unplanned, no roads to enable collection of waste, and waste end up dumped in open spaces. 2. Cultural and socio economic aspects: Functioning of SWM is based on behaviour patterns & underlying attitudes of the population. They are shaped by local cultural and social contexts ; diversity of social and ethnic groups; political landscapes inclusive of policy governance and institutional issues; international influences. Systems approaches to integrated solid waste management in developing countries. Need for a systems approach was identified. **Introduce the importance of involving all relevant stakeholders in WM from prevention to final disposal.** Concerned about the holistic perspective of the solid waste management system **Introduced the need for holistic integrating methodologies that address interconnectedness of sociocultural, environmental, economic and technical spheres. He also examines the challenges presented by economic social cultural, political and international influences in solid waste management**	
P5	Edison Muzenda, Mohammed Belaid, Monsoor Mollagee, NtemiMotampane; Freeman Ntuli	Department of Chemical Engineering University of Johannesburg	Waste need to be converted into a useful product. A useful strategy is needed to do that. They say that before devising a suitable strategy to convert a proportion of the waste into useful product; they say **categorization of waste types is of great significance for any more detailed study.**	2011

	Proceedings of the World Congress on Engineering and Computer Science 2011, San Francisco. Reflecting on Waste Management Strategies for South Africa (1-5)		The paper attempts to parameterize waste generation within a South African Context in order to provide a theoretical foundation for such a framework to take place **Organic materials which included – wood leaves, grass, food, paper plastic, cotton, synthetic fabrics, sewage sludge, animal remains, bacteria any carbohydrates 0r hydrocarbons.** These are all sent to the landfills with the exception of metal, ceramics and glass. Severe backlogs still remain in providing access to adequate municipal solid waste collection services Residents of core urban areas have good access to formal services while those in peri-urban areas and rural areas have limited access. Waste infrastructure includes landfill sites, waste storage facilities, recycling facilities, materials recovery facilities and waste transfer facilities **Energy crisis, global warming and cleaner environment are the most pressing issues facing civilization today** White paper on integrated pollution and waste management (RSA, 2000) **emphasizes a shift from control to prevention.** **They comment that residents of core urban areas have good access to refuse removal services** **Those in peri-urban & rural areas have limited access to formal services** **The quantities of waste are increasing due to increasing urbanisation, incomes changing and changing consumption habits fuelled by globalisation** **Waste Management strategies: Conceptual approach to WM is underpinned by the Waste hierarchy: waste avoidance and reduction; to achieve waste minimization; Recycling and /reprocessing- recovery, reuse and recycling for reclaiming material from the waste stream; Treatment and disposal- minimise the environmental impact by changing the physical properties of waste Countries should move away from landfills. Reduction of greenhouse gases; Climate change. Waste buried in landfills pollutes soil and water and produce methane. WM should focus on**	

			the diversion of biodegradable fraction of municipal waste from landfill sites into energy.	
P6	Mosidi Mokgae South African Nuclear Energy Corporation (NECSA) Pretoria	South African Nuclear Energy Corporation (NECSA) Key areas in Waste management a SA perspective	He list and discusses the types of waste in South Africa, general, hazardous ,and different ways in which they need to be addressed Best Practice Technologies & possible approaches in Waste management. Waste prevention- prevention or avoidance of the production of the certain waste by regulation**.** Waste initiatives address industrial sector as well as schools. In industries it is **prevented by using cleaner technology. In schools & private household it is prevented by broader awareness campaigns.** **Waste minimization**: It is the reduction of the volume of waste during production. It is the application of a systematic approach to reducing waste at source. Resource recovery- recycling of wastes as raw materials**. Recovery of energy through incineration or biodegradation utilizing the resources embedded in waste and contribute to saving raw materials. Waste treatment – reduction of hazardous character of the waste or its volume- to ease environmental or human health risks & impacts** **Waste disposal**- The disposal of waste **in landfills sites. It is ranked the lowest in the hierarchy. It remains to be the** most common waste treatment in South Africa.	2011
Paper	Expert	Field	New Knowledge	Year

P7	Theron Ian and Visser Margaret (2010) Waste Management and the Workplace . The legal Empowerment Agenda: Poverty, Labour and the informal economy in Africa	Labour and Enterprise Policy Research Group Faculty of law University of Cape Town	According to them waste management **refers to collection, transport, processing recycling or disposal of waste materials produced by human activity**. Traditionally this has been collection and transport of waste to the landfill site. South Africa is not an exception to the world it is now paying attention to the **recycling of waste materials as part of a waste minimisation strategy and large numbers of people are employed both in collection of waste and in various processes of recycling.** **Three categories of persons employed in waste:-** Those directly employed by local authorities. Those employed by private contractors or intermediaries providing waste management services to local authorities. Those who collect, sort and sell recyclables in order to survive. They are sometimes called "waste pickers" they have been characterised as self employed. In **Theron's study they are called the self- employed. Some** of them include family units or clusters of people operating together. In Latin America this group has developed to the point where they have formed cooperatives & community based associations. This is still at the infancy stage in SA. ***Theron et al divides the workers into formal and informal economy. Informal economy refers to all economic activities by workers and economic units that are not covered by formal arrangements. It includes / encompasses the self employed and workers employed by contractors/intermediaries. They are not covered or insufficiently covered by formal arrangements i.e labour legislations and other protective regulations*** Workers directly employed by local authorities are protected Contractors and partial agents are partially protected Self – employed are unprotected Workers who are unprotected & partially protected are not regarded as the municipality responsibility	2010
P8	Vijay Kumar & Dr R.K. Pandit		**Solid waste management includes the entire process of dealing with waste starting from :- Collection from primary source, to ultimately disposing it off hygienically so that it is not a nuisance / or create**	2013

	Professor: Faculty of Architecture and Planning University of Science and Technology	Faculty of Architecture and Planning University of Science and Technology	**any harmful effect on nearby community.** Solid waste management involves**: Management of waste at generation level** **Storage at the source of generation, Primary collection, Street collection, Street cleansing, Temporary storage at locality level** **Regular and periodic transportation of this temporary, Collected waste to disposal sites and treatment plants. Reports concerned with SWM produced by Municipal communities in India** **Waste generation is less in small cities / towns than in larger cities** The amount of waste generation is related to the economic status of family. The **Tata research institute reported that higher income groups generate more solid waste than middle and lower income groups. In smaller towns generation of the biodegradable waste is more than non-biodegradable waste** Scientific and systematic storage of waste at source is not in practice **Waste is thrown in nearby vacant areas (land, drains and streets)** **Because of waste thrown on the streets and vacant areas the environments are ugly and unhygienic** No proper dustbins in residential institutional and commercial areas Drains are clogged in so much that large drains are reduced because of continuous dumping Waste is not taken to designated points- People avoid walking to disposal points. It is taken to open plots and spaces and when wind blows, heaps of solid waste are carried away by wind No system of keeping biodegradable and degradable apart No processing of waste is done in most cities They reduce the biodegradable waste to manures by composting	

P9	IAN A. Thompson Domestic Waste strategies in Accra, Ghana and other urban cities in Tropical Development nations	Domestic Waste strategies in Accra, Ghana and other urban cities in Tropical Development Nations	Visitors to Accra are encountered by two narratives **In one side – posh clean Accra with manicured palm trees and amenities of the western world With regular waste removal.** **On the other side the city is congested with illegal settlements substandard housing and poor sanitation** **The predominant experience of most city residents is reflective of growing inequality in Ghana/Accra** **Poor governance has resulted in a city environment characterised by choked drains, clogged gutters and garbage piles heaped in the open**. Landfills are the preferred method of disposal because it is most affordable and requires the least maintenance. Towns select their **own landfill sites. They are not the real landfill sites they are just open dumps**. Engineered disposal sites are not existent in Ghana. Landfills are situated at the outskirts of the city where poorly maintained roads present risks to waste transport. **Leachates from these dumps flow into canals, drainage channels as runoff water poses human health threats.** Presently waste management disposals are underdeveloped. Waste is not subject to contamination. Composting- It is the process of turning organic matter into waste fertilizer through aerobic fermentation. Fertilizer can be used in lawns and gardens. Composting is minimally used in Accra. Only 10 to 15% is composted out of 1250 tons of garbage collected. **Recycling** Only 2% is recycled in recycling facilities. Recycling is practised informally. **Households in low income areas do not dispose waste in the form o plastics, bottles paper, cardboards and cans. They are reused for domestic purpose until they are no longer of use**. In high income areas domestic workers sell these materials to the middleman to supplement income instead of discarding them with the refuse . In Ghana recyclables are Nott separated at source. They do not have	2011

P10	Lillian Abarca Guereerero, Ger Maas, William Hogland, Waste Management and Research 33 (220-232 Built Environment Department, Eindhoven University of technology, Eindhoven Netherlands School of Natural Sciences; Linnaeus University, 82 Kalmar, Sweden Aim of the Research To determine the stakeholders that have an interest in WM systems Factors that influence the performance of the system in 3 continents	Built Environment Department, Eindhoven University of technology, Eindhoven Netherlands School of Natural Sciences; Linnaeus University, 82 Kalmar, Sweden Aim of the Research To determine the stakeholders that have an interest in WM systems Factors that influence the performance of the system in 3 continents	formal waste pickers to collect and sort the waste on behalf of merchants, recycling firms and composition units. They recommend that the waste picker labour market be encouraged to help extend the lifespan of the cities' landfills through waste diversion. Looking at stakeholders in Waste Management and actions and behaviours and factors that influence the elements of the city's waste management systems. Stakeholders identified in WM= National govt, Local govt, municipal authorities, city corporations, non-governmental organizations, households, private contractors, ministries of health, ministries of environment, Ministries of economy and Finance, Recycling companies, Ministry of Agriculture **Factors that have accelerated municipal solid waste generation**. Increasing population levels, booming economy, rapid urbanization, rise in community living standards. The problems are beyond the ability of the municipalities to handle **Factors influencing elements of the WM system** Family size, education system, monthly incomes, households attitudes to separation of waste at source, Participation of communities, fee for collection service based on the waste volume/weight Gender, peer influence, land size, location, of household, membership of environment organization, household waste utilization and separation	2013

P11	Allison Kasozi, Haro Blottnitz Environmental and Process systems Engineering group. University of Cape Town	Environmental and Process systems Engineering group. University of Cape Town for the City of Nairobian contract for the United Nations Environment programme	The aim of the study was to determine the current character on Nairobi's waste. They carried out surveys in communal collection points and households. Waste generators in Nairobi are households, businesses, commerce and institutional premises. Waste types which were collected – organic, which is biodegradable, paper, plastic, glass, metal and other. Waste Collection : **WASTE COLLECTION IN NAIROBI** Some of waste collected at source does not reach communal collection points, it goes straight to disposal dumps Middle to high income residential and larger businesses use door to door private collection Their waste move straight from source to disposal dumps The study showed evidence that there is active informal recovery of and trading of recyclable material in the city This results in a decrease in potential recyclable material at waste collection points and there is an increase in residual waste **Waste recycling and reuse in Nairobi** Inorganic waste recycling in Nairobi is composed of licenced waste dealers who buy from large unregistered individual waste pickers They sell it in bulk to large waste recyclers .waste picking activities in Nairobi are split into two. • There are street waste pickers doing street picking in small open city sites, streets and dustbins • Waste dump pickers who operate at large formal and informal waste dumps- 20% of them reside in the dump itself • Itinerant waste traders or buyers based in the neighbourhoods – they play a role in waste recovery activities, sourcing materials from household waste out for collection • Neighbourhood based waste traders are however decreasing due to security reasons in the residential areas • Waste dealers from the main central link between the accumulated recyclable material quantities from pickers and buyers and large scale waste recyclers who require high large volumes	2010

			• Many waste dealer activities are concentrated around dump sites and are rarely found in higher income areas which are mostly serviced by private collectors (Karanja,2005) • They sell to project which sell to waste dealers but incomes are not sufficient members' living costs • Their problem is securing a stable market for recovered materials especially for paper and compost.	
P12	**Al – Salem , S.M & Baeyens, P.L.J (2009) Waste Management Waste Management : Recycling and Recovery routes of Plastic Solid Waste(PSW) A review. (29) 2625 – 2643)** Centre of Technology, Dept of Chemical Engineering , School of process Engineering, University College of London, Torrington Place	Centre of Technology, Dept of Chemical Engineering , School of process Engineering, University College of London, Torrington Place.	AIM OF THIS PAPER : To focus on the recycling methods of plastic solid waste (PSW) in response to the current waste generation. Reusing plastic is preferred / preferable as it uses less energy and fewer resources. Plastics are called synthetic polymers (plastics) Plastic solid waste (PSW). Their consumption and generation has increased considerable. PSW recycling has been a focus of many researchers. Plastics are used in our daily lives in a number of applications, from greenhouses, mulches, coating and winning to packaging , films, covers, bags, bags and containers. That is why a considerable amount of plastic solid waste is found in the municipal stream of solid waste. PSW treatment & recycling processes are allocated into 4 major categories namely: • Retrusion – primary • Mechanical _- secondary • Chemical _ tertiary • Energy recovery- quaternary Mechanical recycling – that is secondary or material recycling. It involves physical treatment Chemical recycling and treatment – that is tertiary encompassing feedstock recycling. It produces feedstock chemicals for the chemical industry (Troitsch, 1990) Energy recovery involves completer or partial oxidation of the material producing heat, power gaseous fuels, oils and chars besides by-products. Besides by-products it must be disposed of as ash	2009

			Thermoplastic contribute to the total plastic consumption- It is used for plastic applications such as packaging and in non-plastic applications such as textile fibres and coating.	
P13	**Costas, A. Velis; David C. Wilson; Ondina Rocca; Stephen R. Smith; Antorus Mavropoolos and Chris R Cheeseman (2012) An Analytical framework and tool for integrating the informal recycling sector in Waste and resource management systems in developing countries. Waste Management and Research 30 (9) 43- 66.**	Field: School of Engineering , University of Leeds, London, Velis, C. A (Pathogen Control) Engineering Institute, School of Civil Engineering, University of Leeds.	This paper is looking at the Informal Recycling Sector (IRS) which is unrecognised in the city's solid waste and resources management systems. Recent evidence shows that IRS really contributes and achieves a rate of 20-30 % of recycling. It reduces the collection and disposal costs. **Perceived problems associated with the informal recycling sector.** Occupational health , public health and safety, child labour, uncontrolled pollution, untaxed activities, crime, political collusion (These result in them not being integrated into the official system. Who are they: The informal solid waste sector refers to individuals or enterprises who are involved in recycling and waste management activities but are not sponsored or financed, recognised or allowed by the formal solid waste authorities, or who operate in violation of or in competition with the formal authorities. The informality relates to their lack of recognised status within the solid waste sector They are registered and pay taxes like everyone- They are not involved in illegal criminal activities. There is consensus among stakeholders that informal Sector should not be ignored while attempting to improve waste and resource management systems. Research was conducted on how IRS can be included / inclusion/ integrated/integration/ formalised/ formalisation/legalised/legalisation. The international Solid Waste Association Task force on globalisation &WM worked towards preparing guidelines on how best to promote this inclusion.	2012
P14	**Van Aard, A.M and Larney, M- Consumer**	**Apparel Industry Waste Management :**	**Aim of the study:**	2010

	sciences, NW University P/B X6001 Potchefstroom:2520 South Africa. 2010Case study : Apparel industry waste management : Focus on recycling in South Africa: Waste management : Focus on recycling in South Africa: Waste Management and Research 28: 36-43.	**Focus on recycling in South Africa: Waste management : Focus on recycling in South Africa: Waste**	• Identify current solid disposal and recycling practices of the apparel industry in SA • Determine their attitudes & willingness towards recycling • Perception of the feasibility thereof • Barriers to recycling and marketing strategies that would be appropriate for products made from recycled materials **Discoveries:** • Apparel manufacturers use landfills to dispose their waste • Approximately half recycle their waste • Have positive attitudes towards recycling **Barriers to recycling** • Lack of equipment and technology • lack of material to recycle • Lack of consumer awareness • Lack of knowledge regarding recycled apparel proroducts	
P15	**Junya Yano; Yasuhiro Hirai; Shin-ich Sakai; Tsubota Jun (2014) Green house emissions from treatment of household Plastic containers and Packaging: Replacement with Biomass- based materials. Waste Management and Research Vol. 32(4) 304- 316.**	FIELD: Environmental preservation research Centre, Kyoto University Yoshida Honmachi, Sakyo-Ku, Kyoto, Japan Material technology and bio-process Team: Energy technology laboratories, Osaka Gas Company Limited. Torishima, Konohana-Ke Osaka Japan.	Purpose of the study: To qualify the life cycle greenhouse gas emissions reduction that could be achieved by replacement of fossil – derived materials with bio-degradable, bio-mass based materials for household plastic containers & packaging.	2014
P16	**Marcia da Silva Carvalho, Liz Pinguelli Rosa, Andre**	**FIELD : Energy Planning**	The aim of this article is to show that putting solid waste residue (house hold solid waste) to sustainable use is capable of generating economic	2012

	Luiz Bufoni and Luciano Basto Oliveria (2012) Putting solid household Waste to Sustainable use: A case study in the City of Rio de Jainero, Brazil. Journal: Waste Management and Research 30 (12) 1312 -1319	**Programme; Federal University of Rio de Jainero, Brazil**	returns as well as environmental benefits for society as a whole. These economic returns can be used to justify expenditure by public authorities to on sustainable projects and as a basis for society as a whole What does this article do: - Examines the selective collection of solid waste from domestic dwellings in the city of Rio de Jainero - Examines the selective collection of solid waste undertaken by the Municipal urban cleaning company which is a public – private joint corporation controlled by the municipality. Aim: - On the basis that the composition of waste is identified and classified- It proposed that : - Waste residue be put to sustainable use - That its benefits be reported - It needs to reduce the use of landfill sites to a minimum - The maximum residue should be used for generation of energy - As a supply to industry - As a supply to recycling This article is talking to the reutilization of domestic waste for or towards the above factors	
P17	Filho, WL; Kruopiene, J; Moora, H and Stenmark A (2013)	Research and Transfer Centre" Applications of life sciences, " Hamburg University of applied sciences. Lohbrugger Kirsch strabe 65, 21033 Hamburg, Germany Kaunas university of technology, Institute of Environmental Engineering, K.	Purpose of the paper: to analyse how the universities in the Baltic sea region contribute to attempts to achieve a sustainable waste management **This work is an example of mutual benefits- universities view professional research and education as their contribution to sustainable waste management while they gain interesting topics for research, possibilities for capacity building and curricular** enrichment for students. The region has disparities in the ways it handles and processes waste. Meaning that there are some countries that which recover most of the waste they produce while t a number of other nations are lagging behind Explain the contributions of fields / disciplines in knowledge production - Science is aimed at generating the truth	2013

		Donelaicio g. 20, 44249 Kaunas, Lithunia Stockholm Environment Institute Tallin Centre, Lai 34, 10133 Tallinn, Estonia IVL Swedish Environment Research Institute, Box 210 60, 100 31 Stolkholm , Sweden	- Engineering is about changing the world - The world of technology is directed towards changing society - See waste management and treatment as the as the crucial problems in society - Discusses waste management in the Baltic region	
P18	Hansen J, A,; Newman, D, and Hansen J.E; and Neman D. (2012)Where science meets practice: Waste Management and Research	Environmental Engineering, Aarbog University; Arbog Denmark Italian Composting Assosciation ISWA President.	**In their paper they explain that waste management has a scientific touch that increases understanding of the problem of lead pollution**. It provides concrete **leads towards preventive or remedial action.** They mention that natural and social sciences contribute to social justice **and behavioural issues. The coupling of science and experience / practice is the mix that produces interesting articles and advances in sustainable development of resources and waste management at a global scale**, Solid waste management need to focus more on science practice interaction. Where science and practice meet exciting vibrations emerge and opportunities arise for scientists to address real life problems	
P19	Household behavior on solid waste management: a case of Kathmandu metropolitan city		In the early days economists discussed about the socio-economic factors influencing waste generation by the households. Economists also compared the composition and quantity of waste in terms of income level, household size and age structure of the household. The household size, household income and population were important factors affecting the quantity and composition of solid waste. The study shows that grass, yard wastes and newspaper were positively correlated to the level of income (Richardson et al. 1978). The present paper attempts to apply these	

			models in the context of developing country like Nepal with some modification. The objectives of this paper are to discuss household behavior regarding waste generation and management of waste; the relationship of the waste component in different zones within the city; and the "willingness to pay" for changes in the provision of waste management service The objectives of this paper are to discuss household behavior regarding waste generation and management of waste; the relationship of the waste component in different zones within the city; and the "willingness to pay" for changes in the provision of waste management service Findings of the paper: Waste generation is higher in the outer zone and lower in the core zone. This may be due to the sufficient open spaces available in the surroundings of the outer zone. In the core zone people have no space and so they may be generating less waste. (town planning issue) The percentage of people following the separation practice is also very high in the core zone as compared to other zones (Table 4). This may also be responsible for the low waste generation in the core zone. Among the sample households, only 31% of the households reported having separate bins for storage of different types of waste and the remaining households do not have any separate bins. Thus the majority of the households leave their mixed wastes at one place or in plastic bags. Though only 31% households have separate bins, about 65% separate the reusable and recyclable wastes. Among the zones the households having separate bins is the highest (49%) in the middle zone, lowest (7%) in the outer zone and moderate (32%) in core zone. The separation practice is the highest (81%) in the core zone, lowest (52%) in outer zone and moderate (62%) in middle zone. About 57% of the households are served by the door-to-door collection system. The majority of them receive the service by paying the fee and	

			few are receiving the service not because of the fee but because of the location of their house along the road. Normally waste is a function of consumption. The relationship between waste and consumption activities may be expressed as (Richardson et al. 1978): The waste component relationship shows that size of the household and income are the major factor determining the total quantity of the waste in all the zones. It was also found that education has a negative effect on waste generation. Again the environmental awareness of the households seems to be very low and due to this they are willing to pay for environmentally safe land filling. However, they simply want the waste to be out from their house. They are ready to pay only for this. Thus, the average willingness to pay seems to be lower than that of the cost required for the management of the waste. The Willingness to pay is also positively related to the household income and household size. It is found that environmental awareness is very low among the residents of Kathmandu. Thus, stringent regulations with environmental awareness programs for household sorting and composting can reduce the volume and quantity of waste for land filling.	

Appendix 6 : Types of knowledge identified from the research at the level of production

1. What are the underlying principles underpinning knowledge and the knowers in waste management at the level of production

To answer this question using the data collected from the documents I needed to be able to identify knowledge and the knower from the data

I had to understand what knowledge is and what the knower is in this field.

In order to understand knowledge in waste management a framework which clarified the types of knowledge in waste management. (Propositional, Procedural, Theory and Practice).

Propositional knowledge is inclusive of the following:

TYPES OF KNOWLEDGE	EMPHASIS ON	INDICATOR	EXAMPLES FROM EMPIRICAL DATA
Propositional knowledge	Knowledge what exists only in abstract form. Arrived at through a process of logical deduction	ER- types and names of things	**Waste types;** paper, cardboard, plastic, glass etc.
		ER+ categories of things	Categories of Waste; organic, biodegradable, non-biodegradable, inert, hazardous etc.
		ER + Concepts	Waste, reduce, reuse, recycle, disposal, landfill
		ER+ - deeper levels of concepts	Waste management, waste minimisation, waste hierarchy, waste disposal, waste services, waste generation and collection
		ER - Definitions	Waste avoidance is the reduction of waste at source. Treatment is changing of the physical and/or chemical properties of a waste product

Legal Frameworks Knowledge		+ER-	The pieces of legislation included the following pieces of legislation:- • Water Act of 1956 • AtmosphericPollution Prevention Act of 1965 • Health Act of 1977 • Environmental Conservation Act 73 of 1989. Water Act of 1956 sections
Procedural knowledge	Knowledge how (procedures, processes, techniques & skills)	ER + Procedures	Procedures of waste collection: Door to door collection – private collection Separation from source Collection from source
		ER+ Processes	Treatment: The processes of changing the physical and/or chemical properties of a waste product examples : are by compaction, incineration, neutralisation of acids and bases and detoxification of poisons
Technical Knowledge	Pertain to an art or technical skills. Limited to instruction in the principles of science and art applicable to industry. Waste management is inclusive of a p theory part a part of practice	+ ER - Knowledge inclusive of science and techniques (theory and practise)	Where science and practice meet exciting vibrations emerge and opportunities arise for scientists to address real life problems. Examples are given below: Under chemical recycling process appear the following processes: Pyrolysis, Gasification, Liquid-gas hydrogenation.
			Treatment: The processes of changing the physical and/or chemical properties of a waste

			product examples : are by compaction, incineration, neutralisation of acids and bases and detoxification of poisons

2. I had to work on languages of description for the knower to assist me to be able to move in between the data and theory

Appendix 7: Knower and social aspects knowledge identified from the Research Papers : At the level of production			
Political aspects	**Financial / Socio-economic**	**Socio-cultural**	**Places of abode and inequalities**
In developing countries there are scaring inequalities, varying economic, cultural, socio-economic and political landscapes, governance, policy, institutional and responsibility issues	Landfilling is the cheapest and most convenient method of waste disposal	Before considering a recycling programme it is necessary to consider the involvement of the general public	They comment that residents of core urban areas have good access to refuse removal services
SWM systems in developing countries examines the challenges presented by economic, social , cultural, political and international influences.	Recovery of energy through incineration or biodegradation utilizing the resources embedded in waste and contribute to saving raw materials.	Waste management refers to collection, transport, processing recycling or disposal of waste materials produced by human activity.	Those in peri-urban & rural areas have limited access to formal services Waste services not accounted for in rural towns. Staffing in these areas is skewed towards labourers
International influences have created technical and non-technical challenges of immense complexity in developing countries around SWM (Konteh, 2009).	Generators from low income areas whose residents form 60% of the city 's greatest – population their characteristic is that they have a limited ability to pay for solid waste management services. In developing countries there are scaring inequalities, varying economic, cultural, socio-economic and	Prior to year 2000 developed countries never considered social aspects . They focused only on economic and environmental aspects (Morrisey & Browne, 2004) In developing countries there are scaring inequalities, varying economic, cultural, socio-	Many cities in low income countries experience the problems that were experienced by the high income countries in the 19th century, for example, high levels of urbanization, degrading sanitary conditions, unprecedented levels of morbidity and mortality (Wilson, 2007).

	political landscapes, governance, policy, institutional and responsibility issues. International influences have created technical and non-technical challenges of immense complexity in developing countries (Konteh, 2009).	economic and political landscapes, governance, policy, institutional and responsibility issues. International influences have created technical and non-technical challenges of immense complexity in developing countries (Konteh, 2009).	In developing countries there are scaring inequalities, varying economic, cultural, socio-economic and political landscapes, governance, policy, institutional and responsibility issues
The greatest challenge in low- income countries is "to strike the balance between policy, governance, institutional mechanisms and resource provision and allocation".	Generation from high income and middle income areas (constitute 40% of the population) can pay for their services – manage to pay for their services	Secondly none considered involving all stakeholders namely stakeholders from government officials, industry, formal private sector services, to local communities and rag pickers.	People stay in slums and sanitary conditions in slums are appalling. Settlements are neglected. There is no space for refuse containers and the roads are unsurfaced; conditions which effect the movement of vehicles of collection.
In low income areas inadequate formulation and implementation of realistic policies have been realised. There is civil unrest and political instability which contribute to the problems of waste management.	Another group of generators are commerce / business, small enterprises and larger establishments associated with affluent ownership	Methodologies need to integrate methodologies that show connectedness of socio-cultural, environmental, economic and technical sphere	There are no spaces for waste burial and composting. This result in space being dumped in open spaces, access roads and in water ways. Waste clog drains creating nurseries for dangerous insects like mosquitos.
Social and political urgency take precedence and	Consideration need to be given to sustainable markets for recyclable	SWM systems in developing countries examines the challenges presented	The systems must be appropriate to the particular circumstances,

leave a very small budget to be utilized for waste management projects.	products during Waste generation	by economic, social , cultural, political and international influences.	problems of the city, locality employing and developing the capacities of all stakeholders including households, and communities requiring service, private sector enterprises, workers both formal and informal and government agencies at the local , regional and national levels.
Low income countries lack the appropriate governance institutions and structures such as public policy institutions found in high income countries.	These live in a cluster of high income low density neighbourhoods. In such areas curb side pickup is provided weekly. Residents are charged a fee for service and an additional fee to lease the garbage containers	Historically public health concerns, security, scarcity of resources and aesthetics have been drivers of waste management systems (Wilson, 2007; Worrel and Versilind 2012).	Conditions in low income countries. Rapid urbanization takes place Low income people are moving to cities
Weak institutions have also been identified as a major problem in emerging and developing countries For example the polluter pays concept is inappropriate and not working for many countries because of lack of enforcement. Lack of enforcement of legal	The other 80% receives the service for free. They live in low income areas. Trucks are supposed to collect weekly but service is variable because collections are less lucrative and less reliable. (No profitable)	When progress in waste management finally began it was driven by five factors namely, public health, environment, resource scarcity, the value of waste, climate change, public awareness and participation.	That results in the rapid growth of cities and metropolitan areas The large urban agglomerations represent an enormous challenge for environmental service

frameworks therefore cause large generators to dump illegally. Data of waste generation is often unreliable.			
Waste management budget always serve half of the population and lack of funds prevents capacity buildings and improvement of waste management capacities.	A pay as you dump method was tried, a person was made to stand next to the container and collect the fee, The policy failed to be sustainable as residents avoided the central collection container.	Animals and waste pickers scatter the waste and leachate which results in contaminated food, water, soil, serious environmental and health conditions. Implications are health implications especially for the vulnerable children and the elderly.	Smaller cities are facing urban environmental management problems Slums grow at an alarming rate Results in the lack behind of waste management services
In the absence of strong political and cultural drivers International Financial Institutions act as key drivers of waste management development in the developing countries.	Waste dealers- buy from pickers and buyers concentrated around the dump sites not found in high income areas as they are serviced by private collectors. Waste generated on a daily basis varies significantly Economic standing is a determinant of how much a city produces There is an increase of waste generation rates with higher GNI (Gross National Income).	Cultural and social aspects which are contributors to waste management problems in developing countries are: Increasing urbanisation Socio-economic disparities, Inadequate provision of sanitary and environmental amenities Social exclusion and inequalities relating to existing waste management High levels of morbidity High levels of mortality linked to inadequate sanitation,	Large differences between rural areas and urban areas. Waste generation also vary according to city sizes.

		waste disposal and water supply provision.	
They bring conventional techniques and approaches from the industrial countries for example imported sophisticated vehicles and equipment for collection, treatment and disposal of waste.	Before considering a recycling programme it is necessary to consider the following: Involvement of the general public Recycling agencies – secure markets Waste composition-is influenced by wealth	Waste management in developing countries is based or founded on the behaviour patterns and underlying attitudes of the population. Waste composition-is influenced by wealth but: Not only wealth but also consumer patterns significantly influence waste composition. High content of bio-degradable matter & inert materials result in high waste density & high moisture content (what consumers eat & their activities) Physical characteristics influence the feasibility of certain treatment options They also determine the type of vehicles and systems used for collecting Vehicles & systems used in / with low density wastes and as industrialised countries will not be suitable or	Waste composition-is influenced by wealth Not only wealth but also consumer patterns significantly influence waste composition. High content of bio-degradable matter & inert materials result in high waste density & high moisture content (what consumers eat & their activities) Physical characteristics influence the feasibility of certain treatment options They also determine the type of vehicles and systems used for collecting Vehicles & systems used in / with low density wastes and as industrialised countries will not be suitable or reliable under such conditions (or Biodegradable matter & inert material). Extra weight, abrasiveness of the inert material such as sand and stones &

			corrosiveness caused by the water content
Use of these exported technologies later becomes too expensive and difficult to maintain, and experience an absence of technical expertise with operational and management capacity to maintain them. Jha et al. 2011, Yousif & Scott, 2007, Schubeler, 1996 p.19 are calling for the utilization of waste management methods which are considered and tailored according to the individual needs of the communities concerned.	Waste is minimised Packaging selling and consumption of goods that produce waste Socio-economic status influences the composition of the waste, for example, wealthy groups discard durable items instead of repairing them and the high literacy groups discard high volumes of paper.	Municipal capacities are influenced by the diversity of the social and ethnic groups contained in their local, cultural and social contexts. Schubeler , 1996 p.19 are calling for the utilization of waste management methods which are considered and tailored according to the individual needs of the communities concerned.	In Asia waste management is not a service delivered by urban authorities only but by a cooperative undertaking that requires the coordination of informal behaviours of conventional management approaches. There
	Improving production and packaging designs to reduce resource production Changing marketing and sales approaches Extended producer responsibilities - of producers of products which require producers to accept	Public awareness and attitudes towards waste impact on waste management systems from household storage to separation and waste reduction. In some areas for example, waste collection is not seen as an honourable profession.	

	their used products back for recycling.		
Use of these exported technologies later becomes too expensive and difficult to maintain, and experience an absence of technical expertise with operational and management capacity to maintain them. Jha et al 2011, Yousif& Scott, 2007; Schubeler, 1996 p.19 are calling for the utilization of waste management methods which are considered and tailored according to the individual needs of the communities concerned.	The choice of the disposal should be based on evaluation of economics and potential pollution risks These become expensive and difficult to be maintained by the developing countries. The approaches used by the International Financial Institutions are not always the ones appropriate for the contexts of the clientele.	SW collection and disposal are also influenced by the social aspects. If large quantities of odour generating foods (for example fish) are consumed collection should be more frequent especially in warm climates. Some groups dispose in containers while others see the streets as places to dispose on. They are happy as long as waste removed from their households.	Waste management should be tailored according to specific community goals by incorporating stakeholders' perspectives and needs, local context and the optical combination of available appropriate methods of prevention, reduction, recovery and disposal.
	Solid waste strategies address the health, land use, resource and economic concerns. Waste management budget always serve half of the population and lack of funds prevents capacity buildings and	They are happy as long as waste is removed from their households. They do not see the open spaces as areas to be conserved but as dumping areas	It should involve public participation and empowerment, decision transparency, networking, co-operation and collective action, communication and accessibility of information (Carabius et al, 1999; Dijkema et al, 2000; Henry et al, 2006 and Marshall

	improvement of waste management capacities.		& and Farahbakhsh, 2013).
	Methodologies need to integrate methodologies that show connectedness of socio-cultural, environmental, economic and technical sphere	See WM as a complex task and therefore call for multifaceted WM methods that are considered at a case to case method. They should be considered according to each community's individual needs. WM systems must be carried out by the society and its local communities	
	SWM systems in developing countries examines the challenges presented by economic, social , cultural, political and international influences.	WM requires technical solutions, sufficient organisational capacity, and cooperation between a wide range of stakeholders It is interdisciplinary and multi- sectoral (includes manufacturing, transportation, urban growth and development, land use patterns public health.	
	Historically public health concerns, security, scarcity of resources and aesthetics have been drivers of waste management systems (Wilson, 2007; Worrel and Versilind 2012).	It highlights interactions between physical components of the system and conceptual components that include the social and environmental spheres.	
	Informal recycling is carried out by waste pickers who value much of what might	Waste management engages a broad community of stakeholders and	

	otherwise enter the waste stream Use of these exported technologies later becomes too expensive and difficult to maintain, and experience an absence of technical expertise with operational and management capacity to maintain them. (Jha et al 2011, Yousif & Scott, 2007; Schubeler, 1996 p.19) are calling for the utilization of waste.	therefore demands WM approaches that recognise social aspects, cultural, political and environmental spheres. It has direct impacts (transportation, collection, treatment and disposal) and indirect impacts – use of waste materials, and energy outside the waste management system.	

Infrastructure	Environment	Resources & awareness	Health
Change in the way products are designed and manufactured in order to promote their reuse and recycling (by who)	Reduction of hazardous character of the waste or its volume- to ease environmental or human health risks & impacts	Change in the way products are designed and manufactured in order to promote their reuse and recycling (by who)	Reduction of hazardous character of the waste or its volume- to ease environmental or human health risks & impacts
The unplanned growth has resulted in amber of extreme land use planning and infrastructural challenges.	Recovery of energy through incineration or biodegradation utilizing the resources embedded in waste and contribute to saving raw materials.		Waste treatment – reduction of hazardous character of the waste or its volume- to ease environmental or human health risks & impacts
Before considering a recycling	Before considering a recycling	Before considering a recycling	Before considering a recycling

programme it is necessary to consider the Accessibility _ Road infrastructure and conditions	programme it is necessary to consider the following: Involvement of the general public Recycling agencies – secure markets	programme it is necessary to consider the education of community	programme it is necessary to consider the Involvement of the general public Recycling agencies – secure markets
Available facilities and and infrastructure : Appropriate vehicles Available expertise Distance to the disposal sites- transfer facility requirements	Waste prevention-or avoidance of the production of the waste by regulation. In industries is prevented by using cleaner technology	Methodologies need to integrate methodologies that show connectedness of socio-cultural, environmental, economic and technical sphere	Waste prevention-or avoidance of the production of the waste by regulation In schools & private household it is prevented by broader awareness campaigns.
Promote waste minimisation by creating infrastructure to enable waste to be diverted from landfill sites (What is that infrastructure see Gazette of 2012 above.	The choice of the disposal should be based on evaluation of economics and potential pollution risks	Historically public health concerns, security, scarcity of resources and aesthetics have been drivers of waste management systems (Wilson, 2007; Worrel and Versilind 2012).	Impacts from landfills Odours and general inconveniences for neighbours to landfill cites
Developing infrastructure for processing waste for reuse/ recycling (infrastructure	Environmental impacts from landfills Contribution to the greenhouse effect through the emission of the methane gas Leachate which may damage groundwater if there no liner system Odours and general inconveniences for neighbours to landfill cites	When progress in waste management finally began it was driven by five factors namely,: public health, environment, resource scarcity, the value of waste, climate change, public awareness and participation.	Solid waste strategies address the health, land use, resource and economic concerns.

	Solid waste strategies address the health, land use, resource and economic concerns.		Historically public health concerns, security, scarcity of resources and aesthetics have been drivers of waste management systems (Wilson, 2007; Worrel and Versilind 2012).
	Methodologies need to integrate methodologies that show connectedness of socio-cultural, environmental, economic and technical sphere		When progress in waste management finally began it was driven by five factors namely, public health, environment, resource scarcity, the value of waste, climate change, public awareness and participation.
	When progress in waste management finally began it was driven by five factors namely, public health, environment, resource scarcity, the value of waste, climate change, public awareness and participation.		The distances between landfill sites and the urban centres raise the transport costs of waste. Government therefore need to have institutional structures with clear roles and responsibilities of institutions and government bodies to avoid controversies and ineffectiveness thus making waste management systems politically unstable (Coffy & Coad, 2010).
	Human activities create waste and it is the way it is handled, stored. Collected and		Human activities create waste and it is the way it is handled, stored. Collected and

	disposed which can pose risks to the environment and to the public health.		disposed which can pose risks to the environment and to the public health.
	Such inadequate waste disposal creates serious environmental problems that affect health of humans and animals and cause serious economic and other welfare losses.		Such inadequate waste disposal creates serious environmental problems that affect health of humans and animals and cause serious economic and other welfare losses.

APPENDIX 8 : Knowledge and information analysis of content knowledge from the National Waste Management Act No. 9 of 2008

	Special Knowledge/ Environment	Economic	Technical	Knowledge related to people experiences/ Social	Legislation	Institutional and planning issues	Roles and responsibilities of spheres of government officials
	Purpose • To protect the health and the environment by prevention of pollution and ecological degradation and for securing ecologically sustained development • To have an environment protected for the benefit of the present and future generations through legislations that : • Prevent pollution and ecological degradation • Promote conservation and	Ensure that funds from waste services are used for WM services Provide for tariffs to be imposed to provide for waste management infrastructure or facilities Waste under certain circumstances is a resource and offers economic opportunities	Treatment - any method or technique or process that is designed to: Change the physical, chemical or biological character or composition of waste Remove, separate, concentrate or recover a hazardous or toxic component of waste	To protect the health and well being of the people Everyone has a right to have an environment that is not harmful to his or her health and well being Persons need not dispose waste negligently Persons need not permit waste to be disposed in or in any land Persons need not dispose waste in a way that is likely to cause pollution on environment Or harm health and well being	Waste and management practices require national legislation to maintain essential national standards Require uniform norms and standards that apply throughout the republic Requires norms and standards that seeks to ensure best waste practices within a system of co-operative governance To have an environment protected for the benefit of the present and future generations through legislations that :	Achieving integrated waste management reporting and planning To provide for institutional arrangements and planning matters Develop procedures on the reporting on the plans Designate officers responsible for co-ordinating national government matters Designate officers to coordinate matters	Designate officers responsible for co-ordinating matters at national, provincial and local government Develop waste management plans to be submitted to Minister for approval Develop contents of the integrated management plans Develop waste management plans to be submitted to Minister for approval

					Prevent pollution and ecological degradation Need to fulfil the rights contained in section 24 of the constitution It needs to put in place measures/ legal frameworks that seek to reduce the amount of waste that is generated To provide for national norms and standards for regulating the		
	Types of Waste and their definitions • Building and demolition waste- excluding hazardous waste, produced during the construction of alteration, repair or demolition of any structure • Business waste- the one that emanates from premises that are used for	Secure ecologically sustainable development while promoting justifiable economic and social development	Incineration - any method or technique or process to convert waste gases and residues by means of oxidation Recovery – the controlled extraction of a material or the retrieval of energy to from waste to produce a product Change the physical, chemical or biological character or composition of waste	Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development Govt need to ensure that people are aware of the impact of waste on their health, well-being and the environment	management of waste by all spheres of government Establishment of the national strategy for achieving the objectives of the Act. Minister need to develop norms and standards for National, Provincial and municipalities Waste and management practices require national legislation	To provide for institutional arrangements and planning matters To provide for the national waste information system To provide for compliance and enforcement To provide for licencing and control of waste management activities	

	commercial, retail, wholesale, entertainment, and government administration purposes • Domestic waste- excluding hazardous and emanates from premises that are used mainly for residential, educational, health care, sport and recreational purposes • General waste – waste that does not pose an immediate hazard or threat to health or the environment and includes • Hazardous waste – any waste that contains organic or inorganic elements, or compounds owing to the inherent physical, chemical or toxicological characteristics of		Remove, separate, concentrate or recover a hazardous or toxic component of a waste	No person may drop , deposit spill in any other form or discard litter into any public place To ensure that people are aware of the impact of waste on their health well-being and the environment	and national standards that apply throughout the republic -	Consultative processes need to be utilised for any decision made Contents of the integrated management plans are listed Procedures on the reporting on the plans are set -	

	that waste, have a detrimental impact on health and the environment. • Inert waste – does not undergo any physical, chemical or biological • Container- means a disposable or re-usable vessel in which waste is placed for the purposes of storing, accumulating, handling, transporting, treating or disposing of that waste and includes bins, bin-liners, and skips.						
Processes/procedures of the Waste Hierarchy	**Processes/procedures of the Waste Hierarchy** • Minimisation – the avoidance of the amount and toxicity of waste that is generated and in the event that waste is is generated, the reduction of the			Remediating land where contamination presents or may present a significant harm or risk to health or the environment To give effect to section 24 of the	-		-

	amount and toxicity of the waste that is disposed of. • Recovery – the controlled extraction of a material or the retrieval of energy to from waste to produce a product • Recycle- a process where waste is reclaimed for further use a process which involves, the separation of waste from a waste stream for further use and the processing of that separated material as a product of a raw material. • Reuse – to utilise materials from the waste stream again for a similar or different purpose without changing the form of or properties of the articles.			Constitution in order to secure an environment that is not harmful to health and the wellbeing		

	• Storage - accumulation of waste in manner that does not constitute treatment or disposal of that waste • Treatment - any method or technique or process that is designed to: • Change the physical, chemical or biological character or composition of waste • Remove, separate, concentrate or recover a hazardous or toxic component of a waste • Incineration - any method or technique or process to convert waste gases and residues by means of oxidation					

APPENDIX 9: KNOWLEDGE AND SOCIAL ASPECTS FROM THE NATIONAL WASTE MANAGEMENT STRATEGY NOV. 2011

Red: social

Gold : Infrastructure and planning issues and legislative issues

Green: Economic

Blue : Knowledge and scientific issues

Black: Legislative issues

Executive Summary :

The National Waste Management Strategy is a legislative requirement of the National Environmental Management Waste Act, 2008 (Act 59 of 2008) Its aim is to achieve the objectives of the waste act.

Challenges the NMS is trying to act against.

- A growing population – which means/ results in increased volumes of waste
- Complexity of waste streams – because of urbanisation and industrialisation. The complexity affects the complexity of the waste stream.
- A historical backlog of waste services especially for urban informal areas, tribal areas and rural formal areas.
- 61 % of SA households had access to domestic waste collection services in 2007, but it is skewed in favour of more affluent and urban communities.
- Inadequate waste services lead to unpleasant living conditions
- Limited understanding of the main waste flows and national waste balance because the submission of waste data is not obligatory and where available is often unreliable and contradictory.
- Policy and regulatory environment that does not actively promote the waste management hierarchy. (Legal issue)
- This has limited economic potential of the waste management sector- this sector has an estimated of approximately 10 billion per annum. Both waste collection and the recycling results make meaningful contribution to job creation and the GDP.
- Absence of recycling infrastructure – which enable separation of waste at source and diversion/ division of waste streams,
- Outdated waste management infrastructure
- Waste management suffer from under pricing – which means the cost of waste management is not fully appreciated by consumers and industry and waste disposal is preferred over the options.
- Few waste treatment options are available and so they are more expensive than the landfill costs.
- Too few adequate, compliant landfill and hazardous waste management facilities, which hinders healthy disposal of all waste streams.- There is a large number available but a significant number is unpermitted.
- Challenges are social, economic, regulatory, infractucture and systemic

The waste management hierarchy is the overall approach that informs waste management in SA today. It consists of options for waste management during :

- Life cycle of waste arranged in a descending order of priority
- Waste avoidance, reduction, reuse, recycling, recovery and treatment and disposal as the last resort.

GOALS OF THE NWMS and Targets

GOAL	Target
Promote waste minimisation, reuse, recycling and recovery of waste	25% of recyclables diverted from landfill sites to reuse, recycling and recovery
Implement the waste management hierarchy and with the ultimate aim of diverting waste from landfill	Initiate separation at source programmes. Achievement of waste reduction & recycling targets for paper and packaging
Ensure effective & efficient delivery of waste services	95% of urban households and 75% of rural households to have access to adequate levels of waste collection services
Grow the contribution of the waste sector to green economy	69,000 new jobs created in the waste sector. 2600 SMME's & cooperatives participating in waste services delivery& recycling
Ensure that people are aware of the impact of waste on their health	80 running of local awareness campaigns 80 of schools implementing waste awareness programmes
Achieve integrated waste management planning	All municipalities have integrated IWMPs. All waste management facilities required to report to SAWIS
Ensure sound budgeting and financial management for waste services	All municipalities that provide waste services should conduct full cost accounting for waste
Provide measure to remediate contaminated land	Assessment for 80% of sites reported to the contaminated land register
Establish effective compliance with and enforcement of the waste act	50% increase the number of successful enforcement actions against non-compliance

To achieve these 8 goals a toolbox of waste management measures have been created.

1, Waste classification and management system- It provides methodology for the classification of waste and provides standards for assessment and disposal of waste for landfill disposal
2. Norms and standards – establish baseline regulatory standards for managing waste
3. Licencing – lists activities and those that do not – if undertaken according to conditions
4. Industry management plans – enable collective planning by industry to manage their products once they become waste & to collectively set targets for waste reduction, recycling and reuse.
5. Extended producer responsibility_ regulates that industry is responsible beyond point of sale for particular products that have toxic constituents or pose waste management challenges – particularly where voluntary waste measures have failed.
6. Priority waste _ identifies categories of waste that their risks to human health & environment require special waste management measures, particularly where a solution requires involvement of multiple role players.

CLASSIFICATION OF ROLES TO BE ACHIEVED BY NUMEROUS ROLE PLAYERS

Government : Draft legislations, regulations, standards and IWMPs
Regulate waste management activities through licensing & enforce their conditions.
Co-ordinate waste management activities using a systems of waste management officers.
Implement the South African Waste Information System
Give effects to multilateral agreements and ensure proper import and export controls
Expand access to basic level of waste service
Facilitate establishment of a national recycling in frastructure
Provide a framework for the remediation of contaminated land
Work in partnership with the private and civil society

CIVIL SOCIETY:

Separate waste at household level.
Participate in waste awareness campaigns
Participate in recycling initiatives
Comply with waste regulations, prevent littering
Help to monitor compliance.

Background:

Describes the context within which the natural waste management strategy has been developed. This includes methodology legislative context and problem statement
Creates a common platform for action between stakeholders to improve waste management in South Africa
The country is faced with rapidly growing urban population – but our environment has a finite / limited ability to absorb solid and liquid waste.
Sa aims to balance the broader economic and social challenges of a developing unequal society while protecting our environmental resources
There is a need to eliminate the unnecessary use of raw materials and the need to support

- Sustainable product design
- Resource efficiency and
- Waste production

What does that mean to SA / the subfield

- Reusing products where necessary
- Recovering value from products when they reach the end of the life span through:

  Recycling, composting or energy recovery

  While elimination of waste in its entirety may not be possible or feasible- It is seen possible that through systematic application of the waste management hierarchy we can reach a point within the few decades where , reuse, recovery, recycling and treatment overtake landfills as preferred options for waste management.

What is waste?

It means any substance whether or not that substance can be reduced, reused , recycled and recovered.

a) That is surplus, unwanted, rejected, discarded or disposed of.
b) Which the generator has no further use for the purposes of production
c) That must be treated or disposed of
d) That is identified as waste by the Minister by notice in the gazette, and includes waste generated by mining, medical or other sectors
e) Or a by-product not considered waste and any
f) Portion of waste once reused, recycled and recovered ceases to be waste

Given the inclusion of by-products it is important that they be defined:

A by-product means a substance that is produced as part of a process that is primarily intended to produce another substance /or product and that has the characteristics of an equivalent virgin product or material.

Waste management gives effect to outcome 10 of the government wide monitoring and evaluation systems namely that environmental assets and natural resources are well protected and continually enhanced

The outcome consists of several outputs & sub outputs and waste management contributes to two of its outputs

OUTPUT 2: reduced greenhouse gas emissions, climate and improved air quality, waste minimisation, diversion of waste from the landfill , composting & reduced resource consumption will help to reduce Co2 emissions

Output 3: Sustainable Environmental Management less and better managed waste is a key component of sustainable environmental management

Outcome 4: Employment through inclusive economic growth

Waste avoidance & reduction, Re-use, recycling, recovery, treatment & disposal

Promote waste minimisation , reuse , recycling and recovery

1. Waste minimisation in the :
2. Design, composition and manufacturing of products
3. Promote reuse, recycling and recovery of goods and waste materials
4. Waste holders to avoid generating waste and to minimise the amount of toxity of the waste generated. Expected to reuse, recycle of recover waste
5. Duty of care: norms and standards, integrated management plans
6. Extended producer responsibility, priority waste

In response to reuse , recycle and recovery, treatment and disposal – there is a need for co-ordinated effort for generators of waste which include : households, business and organisation to promote reuse, recycling and recovery of waste materials

Producers _ Industry need to take responsibility for the lifecycle of products that they produce:-

Need to establish methods and funding mechanisms to manage the products once they become waste & set targets for reuse recycling and/ recovery

Collection and sorting of general recyclable waste materials supported by a recycling infrastructure

General recyclable waste collection systems will be coupled to existing waste collection services and disposal sites will be transformed into waste management sites.

Material buy – back centres will be established in different municipalities and space will be provided to sort waste into reusable and recyclable waste. (green – what generators need to do: both households and industry- red) (Blue is Infrastructure related work)

Nationally coordinated awareness campaign which support separation of recyclables from the domestic waste stream at source for all households, businesses and organisations

ROLEPLAYERS CONTRIBUTING TO REUSE, RECYCLING AND RECOVERY OF WASTE

Role	General Waste	Organic Waste	Recyclables	Hazardous
Advocacy and Education	Municipality	Municipality with national, provincial & support	Industry in partnership with	Industry
Providing bins at source	Municipality	Municipality	Municipality to provide additional bins at source	Industry
Collection of waste	Municipality	Municipality	SME supported by Industry	Industry
Processing waste	Municipality	Municipality	MRFS by SME and supported by Industry	Industry
Dispose waste	Municipality	Municipality	No disposals as per set target	Industry

Effective waste Management has important economic and social impacts in addition to environmental benefits:

It is an important part of emerging Green economy
A well regulated sector will improve the efficiency of the overall economy
Objectives:

- Stimulate job creation
- Broaden participation by SMEs and marginalised communities
- Formalising the role of waste pickers
- Expanding the roles of SMEs
- Invest in recycling infrastructure to facilitate, reuse, recycling and recovery
- Use labour intensive methods to extend waste collection, services to unserviced communities
- Formalise jobs in the various stages of the recycling value chain including Collection, . sorting, reuse and repair. Product recovery, processing and manufacturing of recyclable materials

- Community – based collection methods & lessons learnt

Environmental	Social	Economic	Regulatory	Infrastructure
		It is an important part of emerging Green economy	A well regulated sector will improve the efficiency of the	Invest in recycling infrastructure to facilitate, reuse, recycling and recovery
		Stimulate job creation Formalise jobs in the various stages of the recycling value chain including		Collection and sorting of general recyclable waste materials supported by a recycling infrastructure General recyclable waste collection systems will be coupled to existing waste collection services and disposal sites will be transformed into waste management sites.
		Broaden participation by SMEs and marginalised communities		Material buy – back centres will be established in different municipalities and space will be provided to sort waste into reusable and recyclable waste.
		Use labour intensive methods to extend waste collection, services to un serviced communities		General recyclable waste collection systems will be coupled to existing waste collection services
		Industry Need to establish methods and funding		disposal sites will be transformed into waste

		mechanisms to manage the products once they become waste & set targets for reuse recycling and/ recovery		management sites.

APPENDIX 10: TRANSCRIPTS OF THE INTERVIEWS IN PROJECT 1 ADMINISTERED THREE WEEKS AFTER THE START OF THE PROJECT

Waste types as identified by beneficiaries in the project						
Beneficiaries numbers	1	2	3	4	5	6
Types of waste identified from home	Paper, Food and peels of potatoes and cabbage , glass, tins, small rocks, soil and sand, old clothing	Paper, plastics, bottles, tins, cow dung, tree leaves and barks, dust from outside, soil and sand, pampers	Plastics, bottles, dust / soil and sand, tins, grass cut and potato peels	Paper and plastics; garden waste, tins and bottles, foodstuffs, dust from outside, soil and sand, sheep manure and poultry manure	Paper and plastics; dust from outside, soil and sand, old clothes , peels of potatoes, cabbage and food; grass and garden weeds, kraal and sheep manure	Paper and plastics; food; bottles both glass and plastic, grass, goats manure; poultry manure; Garden Waste- Old sheets of zink
Types of waste identified from previous schools attended	Paper, cans, orange peels. Unless there was a match. When there has been a match you would find a lot of waste in the form of plastics, papers for sweets, orange peels.	Paper, bottles, plastics, food, old equipment like planks from old desks, Steel frames from old desks, computers, tree branches from pruned trees, tins.	Paper, plastic, glass from broken windows, planks from old desks, steel from broken desks .	Paper and plastics which are brought by the kids who sell sweets and coming from books. Soil and sand which result from sweeping of classrooms	Paper from books	Paper from books, plastic, soil
Types of waste realised and identified in the project	Papers, plastics, cardboard, cans, beer bottles, foodstuffs	Papers (for sweets and chocolates) , plastics, cardboard, pampers. Old food from restaurants and food thrown by people – people do not use bins, when full he just throws what he was eating away on the ground, glass, branches of pruned trees	Papers, plastics, cardboard, pampers, glass, dust and soil which are a result of sweeping	Papers, plastics, cardboard, pampers, bottles both plastic and glass. Old food from restaurants, branches of pruned trees, tins of soft drinks and liquor & tins of beans and fish.	Papers, plastics, cardboard	Papers, plastics, cardboard, pampers, bottles both plastic and glass. Old food from restaurants, branches of pruned trees, tins, food, Dust/ soil or sand resulting from the sweeping, cabbage, banana and orange peels.

How Waste is managed at home

Types of waste	1	2	3	4	5	6
Organic waste:	Organic waste:	Organic waste:	Organic waste:	Organic waste:	Organic waste:	Organic waste:
Peels of potatoes, cabbage food grass and garden weeds kraal and sheep manure	*throw the peels of potatoes and oranges in the garden. They act as manure.*	*In this waste there is waste that can decompose; like tree leaves, peels of vegetables and fruits, cow dung and foodstuffs. It is of benefit to us. we rake it and throw it in the garden especially in winter.* *When the rains come they make it flat and make the soil fertile as it is ploughed into the soil.*	*Put the potato peels in the hole and burn them* *We separate the grass and make compost.*	*We dig holes in the garden and bury them* *We do that with the hope that they will decompose and increase the fertility of the soil* *Sheep manure and poultry manure* *we throw them in the garden and they act as manure* *food stuffs are given as food to pigs and dogs but at home we do not have pigs but our neighbours have . Therefore peels and food are stored in buckets and given to neighbours as food for pigs*	*Food stuff and vegetable, with kraal manure, sheep manure and fruit peels we throw them in the garden- they fertilise the soil* *The garden weeds and grass* *we bury them in the garden*	*with paper, plastic and old clothes and cloths?* *A: Burn them ; BUT WE have been taught not to burn the paper but to bury it in the garden as it will decompose and act as manure* *With goat manure* *we put it in the garden and it fertilises or act as manure* *food stuff, vegetable and fruit peels we throw in the garden* *With green garden waste we* *put it in the garden to fertilise the soil*
Recyclables	Recyclables	Recyclables	Recyclables	Recyclables	Recyclables	Recyclables
Bottles Tins, Plastics Paper	We use to burn – but we were taught that waste is not burnt- burning cause problems in the air	I throw papers away and burn them	with tins? There is a group of mothers which collect them. We collect them , compact them and	The plastics, tins and bottles We throw them in a hole in the garden	paper, plastic and old clothes and cloths? A: Burry them in the garden	with paper, plastic and old clothes and cloths? we burn them ; BUT WE have been taught not to burn the paper but to bury it in the garden as it will decompose and act as manure

	We pick up and sort the waste and put it into different plastics		put them in plastic bags. This group of mothers comes and collect them they take them to Durban.			Sheets of old zinc (metal) we were packing them neatly next to the garden fence and put stones on top so that they are not blown away by wind. Now they are sold to trucks who pass by who are buying metal works
Soil Debri	Soil Debri	Soil Debri	Soil Debri	Soil Debri	Soil Debri	Soil Debri
Small rocks Soil Sand			After sweeping we put Soil in the hole		After sweeping we throw the soil in the garden	soil? A: After sweeping we throw it in the garden
Sanitation issue						
Pampers						
Interventions	A vehicle from the municipality comes and collect the plastics					BUT WE have been taught not to burn the paper but to bury it in the garden as it will decompose and act as manure

How waste is managed in schools

Types of waste	1	2	3	4	5	6
Organic waste:	Organic waste:	Organic waste:	Organic waste:	Organic waste:	Organic waste:	Organic waste:
Peels of potatoes, cabbage food grass and garden weeds kraal and sheep manure	We would pick up all the dirt . In the school there is a hole which has been dug for dirt. We would take that waste to the hole and burn.	For the food- the local people were bringing buckets for waste food to be put in. They used that food to feed the pigs at their homes there was no garden- things		food is something new in the schools. During our time there was no food at school.		

		would be better if there was a garden as some of the things would be thrown or buried in the garden for fertilization purposes				
Recyclables	Recyclables	Recyclables	Recyclables	Recyclables	Recyclables	Recyclables
Bottles Tins, Plastics Paper	In the school there is a hole which has been dug for dirt. We would take that waste to the hole and burn.	Paper and plastic s were thrown in the hole But we were told by our agriculture teacher not to burn the paper as it can be used for composting. We were beaten by vote as most of the learners saw what we were proposing a lot of work and will take more time Tins were also put in the hole and burned.	Plastic were burnt to prevent the plastics from being eaten by the cattle. They die when they have eaten plastics Paper is put into a hole and put the soil on top of it, It is a way of composting.	learners in the school they were sometimes instructed to pick up litter within the school yard. They would pick up the papers and plastics and put them in one heap. A truck would come from the municipality to collect them.	Paper is collected, and we dig a hole put them and cover with soil on top	Waste is burnt in a hole at the corner of the yard collect them. Grass is burnt at school Soil is also thrown in the hole
Soil Debri	Soil Debri	Soil Debri	Soil Debri	Soil Debri	Soil Debri	Soil Debri
Small rocks Soil Sand				The soil and the sand were thrown in the hole the garden		
Sanitation issue						
Pampers						

Planks and steel frames from broken furniture		Desks equipment is fetched by government trucks to refurbished/ repaired. As learners in this school we were day scholars staying far from home and renting in homes around the school , we did not have tables. We used some of the planks to make small tables.	Planks and steel are collected by a truck- it is said that they are taken away to be refurbished			
Interventions				A truck would come from the municipality to collect them. The municipal trucks collect waste from the rural areas not far from town		

WASTE HIERACHY ISSUES COMING UP IN THE HOMES AND SCHOOLS

Activity of the hierarchy	Issues coming up of the data	Indicators from data	Epistemic	Social Aspects
Generation & generators	Home activities- preparation of food, farming activities Paper from children's books			

	Soil from the sweeping the classrooms Plastic and papers from children selling sweets Peels of fruits and when there has been a match School broken furniture			
Waste minimisation				
Waste picking and	At home it is done by members of the families Is done by the students			
Waste sorting	No sorting			
Waste storage	No storage			
Waste collection	Collection by the municipality trucks			
Infrastructure	In rural homes there is no infrastructure In the urban area the Plastic bags are supplied Steel bins Steel cages There is a tip somewhere but the project beneficiaries have not visited it as yet			
Reuse	Peels of vegetables are given to pigs Ash is thrown in the garden for fertility Grass and papers are sometimes buried in the garden	As learners in this school we were day scholars staying far from home and renting in homes around the school, we did not have tables. We used some of the planks to make small tables.		

Recycling	Surfacing here and there in the project	When we clean we decided to pack the cardboard aside as there are people around town man and women who collect the cardboard. When the cardboard is put into the plastics they tear the plastics looking for the cardboard.		
Disposal	Trucks collect waste to the tip There are also dumping sites which have been identified Composting is surfacing here and there	A truck would come from the municipality to collect them. The municipal trucks collect waste from the rural areas not far from town The soil and the sand were thrown in the hole the garden		

Common across the realisations and recognitions of waste in the project

Beneficiaries	Conditions under which they are found	Organic waste	Recyclables	Soil Debri	
1.		, foodstuffs	Papers, plastics, cardboard, cans, beer bottles		
2,	.	Pampers. Old food from restaurants and food thrown by people – people do not use bins, when full he just throws what he was eating away on the ground, branches of pruned trees	Papers (for sweets and chocolates) , plastics, cardboard, bottles, plastics and tins, glass		
3,			A: Papers, plastics, cardboard, pampers, glass	dust and soil which are a result of sweeping	
4,	.	Old food from restaurants, branches of pruned trees,	: Papers, plastics, cardboard, pampers, bottles both plastic and glass. tins of soft drinks and liquor & tins of beans and fish.		
5.			Papers, plastics, cardboard		
6.		Old food from restaurants, branches of pruned trees, cabbage, banana and orange peels.	Papers, plastics, cardboard, pampers, bottles both plastic and glass, tins,	Dust/ soil or sand resulting from the sweeping	

How waste is managed in the project

Types of waste	1	2	3	4	5	6
Organic waste:	Organic waste:	Organic waste:	Organic waste:	Organic waste:	Organic waste:	Organic waste:
Peels of potatoes, cabbage food grass and garden weeds kraal and sheep manure	In each and every area here in town there are bins and a cage. The cage is made up of burglars. I think it is there to prevent the waste from being scattered by the dogs. The members of the community put the waste in the bins. The food is put in a separate plastic There are different types of cardboard the small and the big ones. We put the small ones in plastics and put them with paper. When we have cleaned and put the dirt in plastics we tie the plastics and put them in the cage. The cage is closed	Sweep, pick up the papers, Municipalities have steel bins and steel cages in the municipality. The plastics bags are put inside the bins. The members of the community and the businesses are supposed to put their waste in the bins but they do not care. Most of the time we get the plastics sunk in the bins, bins full as the people just throw anyhow. Others throw next to the bins while others do not use the bins at all. They are saying they are creating more work for us	We put the waste in different plastics tie them and put the plastics in the cages. From the cages the waste is collected by the municipal trucks. I do not know as yet where they take the waste to. A: Put bottles and tins together; put paper and plastics together. Do not put soil into plastics. Plastics are put next to the bins and transferred to the cages and are then collected by trucks. The trucks take the waste to the tip (landfill)	Municipalities have steel bins and steel cages in the municipality. The plastics bags are put inside the bins. The members of the community and the businesses are supposed to put their waste in the bins but they do not care. Most of the time we get the plastics sunk in the bins, bins full as the people just throw anyhow. Others throw next to the bins while others do not use the bins at all.	There are people around town man and women who collect the cardboard. When we put the cardboard in the plastics they tear the plastics looking for the cardboard. Decided to pack them aside for the group to collect. When in plastics we put the waste in the cages. The municipal trucks come and collect the bags. Q: where does the cardboard come from? A: It comes from furniture shops.	Papers, plastics, cardboard, pampers, bottles both plastic and glass. Old food from restaurants, branches of pruned trees, tins, food, Dust/ soil or sand resulting from the sweeping, cabbage, banana and orange peels. The waste is put into plastic bags. Q : What is happening at the tip A: has not been, or visited the tip as yet Q: what is happening in the households? A: Not collected/ worked next to the households as yet works

	The waste is collected by the municipal truck The people moving with the truck collect the plastics from the cage and leave it clean.	cleaners so that we do not lose jobs because of the reason that there is no waste. They put everything together – throw everything in the bin		Put bottles and tins together; put paper and plastics together. Do not put soil into plastics. Plastics are put next to the bins and are collected by trucks' Households put it outside on the street and the municipal truck collects the waste In formal settlements there are bins while there are none in the informal settlements. Though formal settlements have bins they do not care about how waste is handled. They throw waste on the ground, bins		

				are not full but the streets are full of filth. In the slum areas they have created dumping areas which are not authorised by the municipality.		

Appendix 11: "Unit Standard 1 : Separate, handle, store, treat, and transport waste" as found on the SAQA Website (www.saqa.org.za)

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

REGISTERED UNIT STANDARD:

Separate, handle, store, treat and transport waste

SAQA US ID	UNIT STANDARD TITLE			
119555	Separate, handle, store, treat and transport waste			
ORIGINATOR				
SGB Environmental Sc/Mgt & Waste Mgt				
QUALITY ASSURING BODY				
-				
FIELD			**SUBFIELD**	
Field 10 - Physical, Mathematical, Computer and Life Sciences			Environmental Sciences	
ABET BAND	**UNIT STANDARD TYPE**	**PRE-2009 NQF LEVEL**	**NQF LEVEL**	**CREDITS**
Undefined	Regular	Level 2	NQF Level 02	9
REGISTRATION STATUS		**REGISTRATION START DATE**	**REGISTRATION END DATE**	**SAQA DECISION NUMBER**
Reregistered		2015-07-01	2018-06-30	SAQA 10105/14
LAST DATE FOR ENROLMENT		**LAST DATE FOR ACHIEVEMENT**		
2019-06-30		2022-06-30		

In all of the tables in this document, both the pre-2009 NQF Level and the NQF Level is shown. In the text (purpose statements, qualification rules, etc), any references to NQF Levels are to the pre-2009 levels unless specifically stated otherwise.

This unit standard does not replace any other unit standard and is not replaced by any other unit standard.

PURPOSE OF THE UNIT STANDARD

In order for me to perform effectively in the field of environmental science, environmental management and waste management, I will be able to:
- Classify, separate, treat, store and transport waste safely, responsibly and in compliance with legislation
- Control and monitor access to a waste handling facility.

I will also know and understand:
- Principles and concepts related to waste management and their application in practice
- Methods of handling and transporting waste.

I can be assessed against this unit standard in the context of any waste handling activity.
The skill, the knowledge and the values reflected in this unit standard form part of the exit level outcomes required for the National Certificate in Environmental Practice NQF Level 2.

LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING

It is assumed that the learner is competent in Communication and Mathematical literacy skills atn NQF Level 1

UNIT STANDARD RANGE

The scope and level of this unit standard is indicated by range statements related to the Specific Outcomes.

This unit standard is appropriate for learners who specialise in the field of waste management.

Specific Outcomes and Assessment Criteria:

SPECIFIC OUTCOME 1

Separate, treat and store waste.

OUTCOME RANGE

- Includes handling and treatment methods for water, effluent, waste, solids and gas.
- Treatment includes shredding, chopping, baling, compacting, neutralising, blending, incinerating, densifying, etc.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

Waste is separated into the various categories and processed appropriately.

ASSESSMENT CRITERION RANGE

Various categories: general, hazardous, biodegradable, recoverable, etc.

ASSESSMENT CRITERION 2

Handling, treatment and storage methods are selected and applied for each category of waste correctly.

ASSESSMENT CRITERION 3

Work is carried out safely and with due care for self, fellow workers, equipment, materials and the environment.

ASSESSMENT CRITERION RANGE

Safely: correct techniques and procedures are used to handle waste; safe working practices are applied, appropriate protective clothing and equipment is used.

ASSESSMENT CRITERION 4

Environmentally damaging practices are recognised and reported timeously and accurately.

ASSESSMENT CRITERION 5

Incidents and problems related to waste handling, storage and treatment are discussed and explained appropriately and accurately.

ASSESSMENT CRITERION RANGE

Incidents and problems: includes impact of hazardous waste on the environment.

SPECIFIC OUTCOME 2

Transport waste.

OUTCOME RANGE

Transport refers to on-site movement of waste.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

Waste is loaded, moved, off-loaded and positioned efficiently and as required.

ASSESSMENT CRITERION 2

Operations are carried out to quality standards efficiently and safely.

ASSESSMENT CRITERION RANGE

Operations include securing and releasing load, placing load correctly.

ASSESSMENT CRITERION 3

Work is carried out safely and with due care for self, fellow workers, equipment, materials and the environment.

ASSESSMENT CRITERION RANGE

Safely: correct techniques and procedures are used to transport waste; safe working practices are applied, appropriate protective clothing and equipment is used.

ASSESSMENT CRITERION 4

Incidents and problems are reported timeously and appropriate action is taken.

ASSESSMENT CRITERION RANGE

Incidents and problems could include non-compliance with legislation and site or equipment requirements; inappropriate waste; hazardous conditions.

SPECIFIC OUTCOME 3

Control access and monitor the flow of incoming materials to a waste facility.

OUTCOME RANGE

Incoming materials include waste, consumables and equipment.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

Materials are allowed to enter the site in accordance with organisational procedures.

ASSESSMENT CRITERION 2

Non-compliant waste is recognised and appropriate action is taken.

ASSESSMENT CRITERION 3

Security of the facility, equipment and resources is maintained appropriately.

ASSESSMENT CRITERION RANGE

Includes recognising and reporting potential and/or actual breaches of security, accounting for consumables used and storing or immobilising equipment and resources.

SPECIFIC OUTCOME 4

Recognise and report threats or damage to health, safety or the environment.

OUTCOME RANGE

This outcome includes an awareness of appropriate preventive, corrective or remedial actions.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

Potential dangers to health, safety and the environment which can arise during the processes of handling, separating, treating, storing and transporting waste are identified and described accurately and appropriately.

ASSESSMENT CRITERION 2

Measures which can be taken to prevent, correct or remedy threats or damage to health, safety or the environment are explained correctly.

SPECIFIC OUTCOME 5

Compile relevant records.

OUTCOME RANGE

Includes incident reports, operational records, maintaining confidentiality of information (organisational and client).

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

Records are completed accurately, up to date and processed correctly.

UNIT STANDARD ACCREDITATION AND MODERATION OPTIONS

To obtain credits I must be assessed. The assessment will be based on evidence that I produce. My assessment will be governed by the policies and guidelines of a relevant Education and Training Quality Assurance body (ETQA), which has jurisdiction over this field of learning. The policies and procedures of the relevant ETQA will also determine:

- How my assessment is moderated
- How I can appeal against the outcome of the assessment

Any institution or company which offers learning that will enable me to achieve the purpose of this unit standard must be accredited as a provider through the relevant ETQA

.

My assessment against this standard should meet all the requirements of established principles. It should include practical assessment activities, which are appropriate to the contents of this unit standard. These activities should include an appropriate combination of self and peer assessment, practical and oral assessments, observations, etc.

I can be assessed in the language of my choice although if I have to report incidents or conditions to someone else, I will be assessed on my ability to report in the language commonly used in my working environment.

I will be assessed on all the Specific Outcomes, Critical Cross-Field Outcomes and Essential Knowledge Embedded Knowledge. The Specific Outcomes must be assessed in their own right, through oral and practical evidence. My assessment will not only be based on observation but also on other evidence which I compile into a portfolio of evidence. I cannot be assessed only through a written or oral test.

The Specific Outcomes and Essential Embedded Knowledge will be assessed in relation to each other. If I am able to explain the items which fall under the heading of Essential Embedded Knowledge, but am unable to perform the Specific Outcomes, then I cannot be assessed as 'competent'. Similarly, if I am able to perform tasks described under the Specific Outcomes, but cannot explain or justify them in terms of the fundamental concepts, principles and practice relevant to the level of the unit standard that underpins my skill, then I cannot be assessed as 'competent'.

I will also be assessed on my ability to apply the principles and techniques related to the Critical Cross-Field Outcomes, not only in terms of what I can demonstrate, but also in terms of what I know and can discuss.

My assessment for this unit standard can be done in conjunction with the assessment of other unit standards related to a qualification, and even in conjunction with my assessment for the qualification as a whole.

UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE

The following items reflect the type of knowledge that the assessor will evaluate
Names & functions of:

- Types of waste
- Handling and treatment methods

- Terminology related to the waste stream

Purpose of:
- Separating and treating waste
- Inspecting containers and equipment
- Using personal protective clothing and equipment
- Standard operating procedures

Attributes, descriptions, characteristics & properties:
- Properties of the various types of waste

methods of storing, treating and transporting waste
- Characteristics of equipment and materials used in waste handling processes
- Records required
- Personal protective equipment

Processes and events:
- Chemical, physical and biological methods of treating waste

Causes and effects, implications of:
- Effects of chemical and physical properties of waste on equipment, health and the environment
- Benefits and disadvantages of treatment methods
- Not following correct operational procedures

Procedures and techniques:
- Monitoring in-coming waste
- Separating, treating, storing and transporting waste
- Inspecting containers
- Responding to environmental threats
- Dealing with inappropriate waste
- Recording and reporting
- Dealing with emergencies

Sensory cues:
- Related to recognising potential and actual threats or damage to the environment
- Related to anticipating and responding to conditions that could interfere with safe and efficient operations
- Related to maintaining security

Regulations, legislation, agreements, policies, standards:
- R elated to handling, storing, treating and transporting waste
- Related to the site / organisation
- Related to controlling access to the site
- Related to health and safety

Theory: rules, principles, laws:
- Science and technology related to handling, storing, treating and transporting waste
- Optimal payload
- Relevant principles of waste management

Categories:
- Types of waste

Relationships, systems:
- Relationships between the characteristics of the waste and the methods of treatment, storage and transport used

UNIT STANDARD DEVELOPMENTAL OUTCOME

N/A

UNIT STANDARD LINKAGES

N/A

Critical Cross-field Outcomes (CCFO):

UNIT STANDARD CCFO IDENTIFYING

Identify and solve problems
- Related to the characteristics of the waste and the methods of treatment, storage and transport.

UNIT STANDARD CCFO WORKING

Work effectively with others
- Work safely with due care for the health and well-being of others.

UNIT STANDARD CCFO ORGANISING

Organise and manage myself and my activities
- Carry out activities in accordance with procedures for treating, storing and transporting waste.

UNIT STANDARD CCFO COLLECTING

Collect, analyse, organise and critically evaluate information
- Use sensory information to identify types of waste and to monitor the processes of separation, treatment, storage and transport.
- Record information related to separation, treatment, storage and transport of waste.

UNIT STANDARD CCFO COMMUNICATING

Communicate effectively
- Report environmentally damaging incidents.

UNIT STANDARD CCFO SCIENCE

Use science and technology effectively and critically
- Apply knowledge of waste treatment methods to carry out operations effectively and safely.

UNIT STANDARD CCFO DEMONSTRATING

Demonstrate an understanding of the world as a set of related systems
- Recognise the interrelationship between the properties of the waste, the characteristics of the treatment, storage and transport methods, and the impact on the environment.

UNIT STANDARD ASSESSOR CRITERIA

N/A

REREGISTRATION HISTORY

As per the SAQA Board decision/s at that time, this unit standard was Reregistered in 2012; 2015.

UNIT STANDARD NOTES

N/A

QUALIFICATIONS UTILISING THIS UNIT STANDARD:

	ID	QUALIFICATION TITLE	PRE-2009 NQF LEVEL	NQF LEVEL	STATUS	END DATE	QUALITY ASSURING BODY
Elective	49605	National Certificate: Environmental Practice	Level 2	NQF Level 02	Reregistered	2018-06-30	LG SETA
Elective	58785	National Certificate: Production Technology	Level 3	NQF Level 03	Reregistered	2018-06-30	MERSETA

APPENDIX 12: Transcript showing details of content knowledge from the observation video

Unit Standard 19555: Separate, handle, store, treat and transport waste (9 credits)

Introduction

Definition of Waste: Waste is generally defined as any substance be it solid, liquid or gas, that is no longer needed cannot be used or has worn out its use and needs to be thrown away. Waste does not smell good, It does not smell good and it certainly is not nice to live around.

Waste can be divided into natural and human waste. Natural waste are derived from all living organisms (including humans) via the process of simply sustaining life

Examples of natural wastes: breathing, eating , sweating, digestion , building nests and homes, shedding skin , decay, disease and decomposition all produce waste; but these are natural products which are recycled back into the environment.

Humans produce extra waste. Hundreds of years ago societies around the world produced very little waster. The subsistence lifestyle did not require the use of items that were not biodegradable.

As technologies developed our waste production became a little more complicated. Civilisation established itself and cities began to form an accumulation of waste becoming a major problem.

The Industrial Revolution was appointed as the period in which waste management became far more complicated. Advances in complex chemicals, compounds , materials, plastics and pharmaceuticals changed the nature of waste in general.

Waste is never going to disappear. Not as long as humans keep consuming materials goods at the rate we do. There has to be a strict control over how waste is managed (from cradle to grave), following dedicated protocol; backed by policies that promote responsible waste, management. This is in order to prevent environmental damage via pollution and to foster a sense of caring for the environment and for the earth's non- renewable resources. Responsible waste management includes the proper administration , implementation and promotion of recycling facilities and processes; atopic that will be elaborated on in detail.

At the completion of the module you will be able to :

- Recognise environmental pollution risks
- Discuss principles and concepts related to waste management, waste minimisation and recycling
- Classify , separate, handle, treat, store transport and dispose waste correctly, safely, responsibly and in compliance with legislation.
- Control, access and monitor the flow of incoming materials to a waste facility
- Respond to and report threats or damage to health, safety or the environment
- Compile relevant records

UNIT 1 : Environmental pollution and types of waste . At the end one will be familiar with:-

- Will learn about various elements of environmental pollution and the types of waste which exist in the modern world

- Will be familiar with the principles of sustainable development and pollution prevention, the impact of pollution on health and the environment .
- Will be introduced to the broad laws and principles applicable to sustainable development and pollution prevention

Pollution is essentially anything that is added to the natural environment that causes a negative effect . There are different types of pollution:

- Air and noise pollution
- Land pollution
- Water pollution

Air and Noise pollution

This is the pollution accumulation in the atmosphere of substances that , in sufficient concentrations , endanger human health or produce other measured effects on living matter and other materials. The major source of air pollution are the result of power and heat generation, the burning of solid waste, industrial processes and transportation.

Pollution is causing the release of particles into the air from burning fuel for energy e.g. diesel smoke.

Another type of pollution is release of noxious gases such as sulphur dioxide, carbon dioxide, nitrogen oxides and chemical vapours. Further chemical reactions in the atmosphere create smog and acid rain

Noise pollution can have a negative effect on our well- being and can cause long term hearing damage if the noise levels are very high.

Land Pollution

Is the degrading of the earth's land surface through misuse of the soil by poor agricultural practices, mineral exploitation, industrial waste dumping and indiscriminate disposal of urban wastes.

Land pollution is the consequence of increasing populations living in cities and towns and an increase in factories and business . Man's increasing demands on the environment and its resources is putting our planet at risk.

Water pollution

It is the introduction of chemical, physical or biological material into the water systems that degrades the quality of the water and has a negative effect on the organisms living it. Examples include dissolved/ suspended solids, pesticides, heavy metals and non-biodegradable and bio-accumulative chemical compounds.

Types of Waste :

There are various types of Waste that cause pollution with three main categories:

Primary Waste : waste substances produced directly from the source e.g. CO_2 from car emissions, animal waste from abattoirs.

Secondary waste – Waste substances produced when primary waste react with each other and other substances, e.g. leaking organic chemicals in a waste site mixing and forming even more toxic volatile compounds.

Precursor waste – these are waste gases that react in the air to form other pollutants e.g produced nitrogen reacting with sunlight pollutants forming low- level ozone which harms human and animal health

Different types of waste can be further broken down:

Ground waste – waste usually stored in or on the ground both legally and illegally. Waste is generally dumped in large waste pits. There is a great deal of surface litter and toilet pits. Excessive crop spraying, accidents and ammunitions from wars can contaminate the surface and subsurface while mining can mining can often lead to surface, subsurface and deep ground layers of contamination. Unfortunately some pollutants can travel through rock or soil and thereby contaminate wide areas.

Waster waste: Many of the world water sources are badly polluted so much that it is impossible even o clean the water for human use. Most of water-borne waste is raw sewage treated sewage –outflow water from treatment works either into fresh or sea water environments but it includes contaminated storm water, waste water from fish farms, wash water from concentrated livestock facilities like piggeries and abattoirs, cooling water from factories and power stations, concentrated brine water from desalination plants, process water from factories and mining operations

Air waste: The atmosphere provides a massive waste disposal facility that the whole world utilises . Millions of tons of CO2 and other pollutants gases are released into the air every year via industry and the burning of fossil fuels and a sizeable contribution of methane is added via natural processes such as rotting vegetation and volcanic activity. Cause major problems such as smog, lung and skin diseases and depletion of the upper ozone layer which protects us from harmful rays of the sun. These gases are causing the atmosphere to heat up and that is triggering rapid global climate changes. These changes impact on weather, water resources, crop production and human and animal health. Impact on biodiversity and costly damage from droughts, floods, heat waves and storms, all of which are increasing in frequency and severity. Governments are trying to work together to set limits to pollution but global politics and business self interest is hampering decisive actions particularly from mining, oil and fossil energy sectors.

Domestic / Commercial waste

Most people are familiar with domestic waste and commercial waste which is collected by municipal household refuse , trade refuse, garden waste and litter/ dumping cleaning services. Most of these wastes such as the glass, paper and much of the plastics can be recycled into new products. Most of the organic matter, garden cuttings and food waste could be made into compost for use in gardens and crop production.

Industrial Waste: It is complex and toxic to varying degrees. They may be treated off site to make them less harmful. They may be treated off-site o make them less harmful. They may be recycled, reused or re-entered into the production line.

Construction Waste: In the construction and building of houses there are often large amounts of wastes from waste ends to demolition wastes. There is considerable waste in the production of the

building materials themselves. Builders wastes is inclusive of rubble , cement bags, unusable hard goods. Unscrupulous construction companies sometimes do not want to to the appropriate waste facilities where they often have to pay to dump and they dump and run in the convenient side roads and bushy areas leaving the rubble for someone to deal with it.

Agricultural waste: This waste is mostly non-harmful and suitable for composting but it does include some like pesticides and herbicides which are complicated to deal with. Concentrated livestock facilities like piggeries and chicken sheds , produce huge amounts of concentrated manure which can create bad odours and leaching of nutrients into water bodies with consequent significant detrimental impacts. Cattle produce through their urine thousands of tons of methane which contribute significantly to global warming. Processing of agricultural wastes also produces by pesticides and herbicides, effluent from sugar mills canning factories, canning factories, abattoirs, wineries and breweries.

Mining Waste: Mining activities produce significant amounts of waste , many of them cause serious environmental harm. These include vast stock piles of spoil and materials some of which are inert but others are toxic acids which cause serious problems to ground water. It has led pollution of rivers.

Other mining wastes include: Chemicals used in extraction processes e.g. toxic mercury in gold extraction

Effluent flows and washing water, which is often heavily contaminated

Radio-active waste, burning, explosive residues, oil and gas leaks

Considerable CO2 emissions from the fossil fuels.

Electronic waste:

It is comprised of electrical or electronic devices such as computers, shavers, toys, cell phones, TVs and fridges It has been highly fast tracked by rapid advances in technology in the market, low initial cost and planned obsolescence of electrical items. It contains trace valuable elements like gold and copper but may also contain toxic chemicals and heavy metal compounds such as lead, cadmium, mercury, and brominated flame retardants. Recycling and disposal of e-waste may involve significant dangers to workers and the environment especially with informal processing of electronic waste in developing countries.

Hazardous waste:

It contains harmful substances to life and the environment. They typically have one of the following characteristics: infectious, poisonous, radioactive, flammable, explosive, corrosive, carsinogenic (cancer causing), mutagenic – (damages chromosomes), teratogenic (causes defects in the unborn), bio-accumulative (accumulating in the bodies of plants and animals and thus in food chains causing increasing toxic effects up the food chains).

They are produced during industrial, medical, chemical and biological processes, even in households, office and commercial wastes e.g. batteries, pesticides, bleach, paint thinners and their containers. They are very dangerous, costly to handle, store, transport, treat and dispose of.

Sewage:

Humans produce a great deal of sewage which smells foul, attracts vermin, and contains many diseases causing bacteria , viruses and parasite's such as cholera, dysentery, round worms and tape worms. Different societies deal with sewage in different ways e.g. leaving it out in open lands, depositing it in water, burying it, burning it, feeding it to livestock, mixing it into crop fields.

It is sometimes processed in treatment plants. In these plants faeces is decomposed, litter is removed, water is separated out and then piped into fresh or sea water. Such plant accumulate a sludge which periodically scraped out and disposed at wastes sites. The sludge is sometimes composted in gardens and used as fuels and in brick making.

Unit 2: IMPACTS of POOR WASTE MANAGEMENT AND PRINCIPLES OF SUSTAINABLE LIVING

Poor waste management is a key factor in the pollution of our environment.

Health impacts of environmental pollution Pg 14

It depends on a number of factors namely:

- How much pollution there is
- Ages and sensitivities of persons
- A person's general health condition e.g. the very young and the elderly are more easily affected and those with chronic conditions such as asthma, heart or disease, brain damage, nervous disorders and liver or kidney damage.

Health effects of air pollution Pg 14

This is a major cause of health problems which can be both short term and long term

Short term: irritation of the eyes, nose and throat respiratory conditions, pneumonia or bronchitis, headaches, nausea and allergic reactions.

Long term: Chronic respiratory diseases, lung cancer, heart diseases, brain damage, nervous disorders. Noise pollution can lead to partial hearing loss and negative psychological effects.

Health effects of water pollution Pg 15

Cholera, Hepatitis A, bilharzias. Skin reactions and rashes and stomach problems are also common where sanitation services are inadequate.

Health effects of ground pollution Pg 15

Toxic substance being spilled on the ground are washed by the rain off roads and pavements into the surrounding environments. Ron –offs enter soil systems which eventually manifest in plant tissues. Soils and crops absorb unacceptably high levels of toxins which have a negative impact on human health, animals and plants. Ground pollution ends in rivers and streams and can pollute the ground water table which has even further reaching effects.

Why is waste not always well managed Pg 16

- Factors that influence the correct management of waste
- No infrastructure (equipment, vehicles, and roads) to remove waste from houses

- Littering is a problem if there are no refuse bins and if there is no functional system of collection. Without that the bins will overflow.
- People need to be educated on the effects of poor waste management so that they can know how they can make the system work better.
- Laws concerning the collection and disposal of waste need to be enforced and must be must be understood by society.

Who is responsible for pollution prevention

Important environmental laws in South Africa.

Clause 24 of the Constitution

National Environmental Management ACT (Act 107 0f 1998)

National Environmental Management: Waste ACT (Act 59 0f 2008)

Health ACT (Act 63 0f 1997)

National Water ACT (Act 36 0f 1998)

Local Government Municipal Structures ACT (Act 117 0f 1998)

Local Government: Municipal Systems ACT (Act 32 0f 2000)

Occupational Health and safety ACT (Act 85 0f 1993)

Road traffic ACT (Act 93 0f 1996)

Hazardous Substances ACT (Act 15 0f 1973)

Government is the custodian of the environment and is responsible for managing how we care for it. The environmental and related laws have been developed to protect both people and the environment. The laws inform us about how to manage the environment and waste correctly.

NEMA : ENVIRONMENTAL PRINCIPLES

Environmental Principles developed to protect the environment for our generation and future generations:

- **Cradle to grave principle –** whoever starts a project is responsible for all processes and stages until the final stage which was disposal into the landfill
- **Polluter payer principle-** Whoever is responsible for environmental damage or pollution must pay all costs to repair the damage and prevent any further environmental damage
- **Precautionary Principle:** we must be cautious and not take risks in making environmental decisions when the extent of environment or human health in not fully known.

Environmental legislation is the recognition and deep concern that:

- We are causing considerable pollution and other impacts
- We are depleting limited natural resources
- We have to protect these resources by reducing, reusing and recycling our wastes

- Waste management need to be holistically dealt with such as through Zero waste strategies
- Polluters and waste producers must be responsible for the full costs of dealing with waste
- Greater corporate responsibility is required by commitments to high standards of social conduct and employing environmental auditing mechanisms
- Principles of sustainable living should be embedded into everything we do as individuals
- Governments should make sure that the right laws are in place to protect the environment and its people
- We as people should think and act in an environmental aware manner

Laws that affect Municipalities: Page 19

UNIT 3 WASTE classification and waste management

In this unit we are looking at how to classify waste and the logical steps for waste management.

1. **How to classify waste**
2. **The steps for managing waste**
3. **Waste minimisation and recycling**

How is waste classified: Two main categories of waste general waste and hazardous waste.

General waste does not pose a threat to people or the environmental unless it is not managed well.

Hazardous- poses an immediate threat to people and the environment

Types of general waste:

- Domestic waste(household waste, garden refuse)
- Building and demolition waste (builders rubble)
- Business waste (shops, office and non-hazardous industrial wastes)
- Inert waste (waste that does not change , burn, react physically or chemically with other substances, biodegrade or impact negatively on the environment or cause pollution.

Types of hazardous waste:

- Explosives
- Flammable liquids and solids
- Corrosive chemicals
- Toxic substances
- Infectious waste from hospitals and clinics (health care risk waste)
- Radio-active substances

Definitions of general and hazardous waste

General waste is : waste that does not pose an immediate hazard or threat to health or to the environment and includes domestic waste, building and demolition waste; business waste and inert waste. It may contain small quantities of hazardous substances mixed in with it for example batteries, insecticides and other pesticide residues in containers may be thrown away by people in homes or offices.

Hazardous waste:

Any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of the waste have a detrimental (bad) impact on health and the environment. Hazardous waste is dangerous to human health or the environment when it is not treated, stored or disposed of properly. (mismanaged)

Toxic waste : is a poisonous substance that is thrown away which may damage our health by interfering with the way the cells of our bodies work even in very small quantities.

Inert Waste : A type of waste that does not change, burn, react physically or chemically with other substances, biodegrade, impact negatively on the environment or cause pollution. Examples include soil, concrete, ceiling board.

STEPS IN GOOD MANAGEMENT OF WASTE: The hierarchical management of waste

The focus of good waste management is to reduce the amount of waste going to the a landfill site:

1. To avoid making the waste in the first place
2. To minimise the amount of waste generated by reusing or recycling the waste
3. To treat the waste physically, chemically or with thermal treatment to reduce the quantities further
4. Finally what cannot be reused or recycled need to be taken to the landfill site or rubbish site

Diagram below shows how the amount of waste is reduced before it reaches the landfill site, going through the waste management hierarchy

Process	Explanation of the process
Reduce	Lowering the amount of waste produced (most favoured option)
Reuse	Using materials repeatedly
Recycle	Using materials to make new products
recovery	Recovering energy from waste
landfill	Safe disposal of waste to landfill

PARTS OF A WASTE MANAGEMENT SYSTEM

In South Africa Waste must be managed from the point of generation to the point of disposal through careful control of eight functional parts:

1. Waste Avoidance.
2. Waste Generation
3. Separation at Source : Materials recovery for recycling
4. Primary and Secondary Storage
5. Collection
6. Transfer
7. Treatment
8. Disposal

Unpacking of the eight parts individually

Part 1: Waste avoidance

- Avoid creating waste – this needs a mind frame change to take place among individuals and organisations to embrace this e.g. having a shopping bag; joining a lift club.
- The idea of waste avoidance links us directly to the 4Rs
- The 4Rs are :-
- Reduce
- Reuse
- Recycle
- Recover
- Government has made a way of promoting this through alignment with Department of Environmental Affairs and the National Waste Strategy.

Waste can be reduced by:

- Reducing what we consume
- Reusing items several times
- Recycling those things that cannot be used
- Recovering energy from waste that is burnt, or that rots.

Part 2 : Waste Generation

With all the strategies to try and avoid and minimise waste it is difficult to not to produce any waste at all. By buying groceries we bring home loads of packaging that that which we cannot use,

Vegetables that we shall peel to consume, there will be waste generation no matter how conscientious we are. Following the next steps rigorously can reduce the amounts of waste sent to landfills by phenomenal amounts.

3. **Separation at source: Materials recovery for:**

Source can be to the initial source of the waste. – It can be anything from the individual to a family, complex of housing, an office, a factory or even a bin of rubbish. It is the original point at which an accumulation of waste occurs.

Separating at source is important as it simplifies the waste management system. It means a number of things namely:

- Division of waste into categories
- Less time to be spent during sorting when all is put together for sorting
- Sorting of waste to
- What can be recycled and not be recycled

What is recycling ?

It is the process whereby discarded products and materials are reclaimed or recovered, refined or processed and converted into new or different products. It needs both money and infrastructure support especially in early stages of the initiative for it to be successful and sustainable.

Benefits of recycling

It reduces the waste stream going to landfill sites, thus saving landfill airspace

It can create jobs

It helps to reduce pollution and conserve natural resources

It conserves energy and reduces manufacturing costs

It reduces litter

It can reduce informal salvaging from landfill sites

Whose responsibility is it to recycle?

It is everybody's responsibility to avoid making waste then to reuse, recycle, and repair unwanted items before they are discarded as waste. In that way we won't use up the earth's natural resources like oil, minerals and trees too quickly.

What can be recycled:

Common items which include paper, cardboard, cans, scrap metal, plastic, glass, tyres lubricating oils

Unusual items include motor vehicles, white goods e.g. old fridges and microwaves, electronic products, batteries, and construction and demolition materials.

What cannot be recycled?

Dirty recyclable materials

Laminates which are materials made up of mixed layers

Car windscreens

Materials that are uneconomical to recycle because of insufficient volumes or transport distances to markets

Hazardous waste

Recycling in your own home.

1st step – separate your waste at home into organic waste, plastic, glass cans and paper. Cardboard and paper are excellent materials for recycling. For every ton of paper recycled 17 trees are saved. It also reduces the amount of air pollution by 74% and water pollution by 35%

Unit 4 : Waste storage collection, and Transport

In this unit we shall learn how to store waste correctly at the source, how to store hazardous waste correctly , and how to collect , load, transport and unload safely and correctly

Storage - safe containerization of waste

Collection - how waste is picked up and loaded

Transport - how waste is moved and off-loaded

Primary and Secondary storage

Primary storage:

Waste is temporarily stored at the place where it is generated. That is it is generated at source.

Examples of primary storage : rubbish bags, drums, bins and wheelie bins

2. Secondary stage

It is when waste is taken from primary storage to and transferred to a larger container e,g a skip to for transport to a waste disposal. Facility or recycling centre. A shop can have would collect waste in a basket and then it be transferred to a secondary storage area.

Storages must be big enough to hold all the refuse generated until a remover removes it. Materials that can be recycled and reused must be identified and must not be thrown away with the rest of the refuse.

Storage of hazardous Waste

It is more harful to than general waste and needs to be storedin special containersto avoid injuryto people or damage to the environment

Table showing examples of the risks or dangers associated with different types of hazardous waste

Types of hazardous Waste	Risk or danger
Health care risk	Spread of infection
Toxic waste	Acute or chronic toxicity Malignancy Mutations or birth defects Ecotoxity
Radio-active waste	Mutations or birth defects Accumulation in biological food webs or persistence in the environment
Flammable waste	Explosion of fires
Pharmaceutical waste	Acute chronic toxicity
Corrosive chemicals	Chemical instability Corrosion Burns of lesions on the skin

Part 5 : Collection and Part 6 : transport

The two above are interlinked.

Different activities that occur in waste a waste collection system are:-

- Primary collection

- Secondary collection
- Loading and transport to a treatment plant or disposal site
- Un loading

Primary collectors carry waste from source such as household to a collection point – where there is a larger waste container such as a skip. Smaller loads are carried by hand while larger loads can be wheeled in a wheel barrow or smart cart.

Secondary collection is done by vehicle

It can vary from a half ton truck to a large mobile compactor truck.

Loading is either done by hand or mechanically

The vehicle transports the waste to a disposal site

Collection and transport of hazardous waste.

UNIT 5: WASTE TREATMENT

Specific treatments that different types of wastes must undergo before finally being disposed of.

Health hazards that can occur during treatment.

TREATMENT

What exactly is waste treatment?

Treatment is any process that changes the physical, chemical, or biological character of waste to make it less of an environmental threat. Treatment can neutralize the waste; recover energy or material resources from waste; render waste less hazardous or make waste safer to transport, store or dispose.

Type of waste	**Type of treatment**	**Result**
General mixed disposable goods	Compaction- a vehicle squashes the waste to reduce its volume	Waste takes up less storage space Landfill air space is conserved
Garden/ biodegradable	Shredding or chopping of biodegradable waste makes this suitable for composting	Large amount of landfill airspace is conserved The landfill generates less leachate as there is less biodegradable matter. Compost is produces which is marketed to the agricultural industry
Waste oil	Oil recovery	Dirty waste oil mixtures are distilled to produce clean reusable fractions and a sludge residue that can be burned as a fuel or must be land filled at a hazardous landfill
Tyres	Recycling of tyres	Crumbed tyres can be added to road surfacing mixtures Shredded tyres can be used as fuel in cement kilns

		Tyres can be used to stabilise steep banks
Recyclables	Washing of dirty recyclables	Clean materials recyclers will pay more for

Different types of treatment for hazardous waste

Type of treatment	Result
Physical treatment	Physical methods are used to remove toxic or hazardous materials
Chemical treatment	Hazardous nature is lowered by changing its chemical nature
Biological treatment	Microbes are used to reduce the dangerous nature of waste
Encapsulation	Waste is covered with cement to make it safe for disposal
Ash blending	Flammable waste is blended with fly ash to make safe for disposal
incineration	Waste is burnt off at extremely high temperatures to produce non-combustible residue or ash
Thermal/ non-burn treatment	Health care risk waste is treated at high temperature and high pressure to make it non-infectious and safe for disposal

Appendix 13: Unit 195555 Materials for Provider 2

UNIT STANDARD 1: Separate, handle, store, treat, and transport waste

Learning Unit: 3

Unit Standard Number: 119555

Field: Physical, Mathematical, Computer and Life Sciences

Subfield: Environmental Science

Purpose:

In order to perform in the field of environmental science, environmental management and waste management the learner will be able to:

Classify, separate , treat, store and transport waste safely, responsibly and in compliance with legislation

Control and monitor access to a waste handling facility

I will also Know and understand:

Principled concepts related to waste management and their application in practice

Methods of handling and transporting waste

Skills **knowledge and values reflected will form part of the level** outcomes

I Can be assessed against this unit standard in the context of any waste handling activity

The skill the knowledge and the values reflected in this unit standard form part of the exit level outcomes required for the National Certificate in Environmental practice.

SESSION 1 : Separate, treat, and store waste.

LEARNING OUTCOMES

- Waste is separated into various categories and processed appropriately
- Handling , treatment and storage methods are selected and applied for each category and waste correctly
- Work is carried out safely and with due care for self, fellow workers, equipment , materials and the environment
- Environmentally damaging practices are recognised and reported timeously and accurately
- Incidents and problems related to waste handling, storage and treatment are discussed and explained appropriately and accurately

1.1.1 Separate and treat

(1) Recyclable material for the purpose of recycling must not be stored at any premise resulting in risks or nuisance conditions:
(2) A person involved in any way in recycling , must comply with all applicable statutory requirements
(3) Separation of waste or sorting of recyclables shall be performed on the premises, of the point of generation of the recyclable waste stream

(4) All facilities where separation and classification of recyclables material is performed , must comply with applicable statutory requirements.

Glass recycling:

Glass and other recyclables are normally not collected by the RSA municipalities as part of the domestic waste and recyclable materials collection service and must normally be taken to glass recycling banks.

Developers of flats, apartments and sheltered housing schemes, where communal waste storage facilities are installed , are normally encouraged to make additional provision within the bin storage area to accommodate three bins for clear, green and brown glass. Careful consideration need to be given to the positioning and screening of glass recycling facilities to ensure that noise and disturbance in minimised.

Composting of garden waste

Where applicable arrangements should be made in the development of flats to facilitate the onsite composting of materials from the maintenance of communal grassed areas and shrub planting

The appropriate positioning bin for grass cuttings and chipped woody material to provide compost for reuse on site would save transport and disposal costs for grounds maintenance contractors

1.1.2 STORE Waste

Typical specifications for refuse storage areas at multiple dwellings and commercial premises:

The following represents some criteria that may be applied to the establishment of areas where waste is stored at domestic and commercial premises pending removal by the service provider

Floor: The floor shall be concrete , screened to a smooth surface and rounded to a height of 75mm around the perimeter. The floor shall be graded and drained to a floor trap.

Floors and roof. Specifications for places where waste is stored.

The waste/ recycling storage are / room shall be roofed to prevent any rainwater from entering.

The walls shall be constructed of brick , concrete or similar and painted with light colour high gloss enamel, or alternatively, tiled with tiles of a light colour.

The height of a room to the ceiling shall be not less than 2.21 metres.

Ventilation and lighting

The waste /recycling storage area/room shall be adequately ventilated by means of fixed glass louvers.

he room shall be provided with a solid hardwood , lockable door which shall be fitted with an ancient self closing device, and shall have the lower 150 mm protected by sheet metal on the outside. The door and louvers shall be separated at least three metres from any door or window of a habitable room. Adequate artificial lighting is required in the storage area.

Water supply and Drainage

A tap with minimum 12mm diameter standard hose connection shall be provided in the waste/ recycling storage area/room for washing containers and cleaning spillage. The floor should be drained towards a 100mm floor trap

linked to a drainage pipe discharging to a sewer gully outside the building. A grease trap / gully is normally required.

Access:

Council's departmental or contracted waste collection teams will normally enter private property. Therefore the removal of solid waste is effected from the kerbside of a public street. Provision of communal waste/recycling storage area/ rooms will therefore have to be provided on private property immediate adjacent to the nearest public road.

Should the waste/ recycling storage area/room be located at a level different from the level of the street entrance to the property , access ramps are to be provided as stairs are not allowed. The maximum permissible gradient of these ramps is 1:7.

Bays on public street for waste truck to empty waste/recycling storage area/room

A bay with minimum dimensions of 15 meters in length X 2.5 meters in width plus 45 degrees splay entrance, on a public street, must be provided where traffic flows or traffic sight lines are affected

Compaction Equipment:

Any compaction equipment / containers acquired by the building owner must be approved by the municipality, to ensure compatibility with the servicing equipment and lifting attachments of Council, Council's contracted service providers or other private operators.

Screening and Security:

Integrated waste management policy often requires that stored waste should not be visible from a street or public space. Suitable screen walls may be required in certain instances.

Access must be denied to unauthorised persons and waste storage areas should be designed to incorporate adequate security for this purpose. Most municipalities require householders to store in various ways ranging from rubber or plastic. 85 litre bins to 240l wheeled bins.

Around the world the tendency is provide two types of bins, typically one (green) for dry recyclable materials and the second (grey) for general waste.

Determining storage requirements:

When considering the amount of storage space needed for any particular development the following requirements will help to calculate the volume of waste generated. They should only be taken as a guide, since individual developments may need specific storage requirements.

Residential: Requirements and specifications to be considered for areas prescribed for the storage of waste.

Residential dwellings must have adequate storage capacity to allow for weekly collection of waste.

- For developments of up to 10 households
- Households of three bedrooms or less – one 90 litre dustbin supplemented by the use of plastic bin liners or one 240l wheeled bin;
- Households having more than three bedrooms- two 90 litre dustbins supplemented by plastic bin liners or two 240l containers for waste.
- For development of more than 10 households, using communal waste storage containers:
- 55 litres storage capacity per bedroom plus an additional 50% storage capacity for dry recyclable material

OFFICES:

2.6 cubic metres waste storage for every 1,000 M2 gross floor space. Note : 50% of this capacity could be used for the storage of separated waste for recycling

Retail:

5 cubic metres waste storage for every 1,000 M2 gross floor space. Note: 50% of this capacity could retained for the storage of separated waste for recycling.

Restaurants/ fast food outlets

1.5 cubic metres per 20 dining spaces . Note : 50% of this capacity could be retained for the storage of separated waste for recycling. This is not a generally applicable minimum requirement. Certain food outlets especially those of the fast food type , would generate substantially greater amounts of waste. It may be critical to assess each proposal individually.

Hotel

1.5 cubic metres per 20 dining spaces . Note : 50% of this capacity could be retained for the storage of separated waste for recycling. The volume of waste produced depends to a large extent on the type of hotel, since these ranges from short stay bed and breakfast to luxury with full banqueting facilities. The appropriate departments should be contacted at an early stage in the design process to advise on storage apace and equipment requirements.

Each bin is emptied at pre-determined intervals, in South Africa normally at least weekly, and bins / refuse bags must be placed on the edge of the road by the householder for collection. Different arrangements may apply to flats and to specialised forms of housing.

Bylaws may prescribe:

- The refuse storage for various forms of residential development .
- Appropriate ways of positioning , enclosing and screening bin storage areas
- The access requirements of the refuse collection operator.
- Arrangements for the storage and collection of other recyclable material

Housing developers should ensure that these requirement for the storage and collection of domestic waste and recyclables are taken into account at the outset in the design and layout of all new housing developments.

Planning issues:

- Unless proper consideration is given to accommodating refuse bins in the layout and design of a development a number of issues can arise.
- The bins can be prominent and intrusive in the street scene ,particularly in developments at higher densities.
- Where housing is situated close to, or on the back edge of the footway or pavement , bins can be left obstructing the pavement.
- Bin storage areas can be inconveniently located for residents or in accessible to refuse collection crews;
- Bin storage areas that are poorly sited and designed can result in a loss of amenity for residents due to noise and odour.

Page 97 – Pg 98 Pictures of different kinds of bins

Page 99- picture of a Bin for waste compactors on top followed by information.

All bins must be conveniently located for use by residents and must be easily manoeuvrable to the edge of the road for emptying.

In order that the refuse collection vehicle can reach the bin storage area serving flats, appropriate hard – surfaced manoeuvring space must be provided.

Typical Municipal requirements:

Council requirements for the storage of refuse bins should be incorporated in all proposals for residential development:

Bin storage areas must be convenient for use by residents with easy access to the roadside. There will be no specific need for screening unless the storage area is prominent in views from the road. A footpath or other public vantage point.

For flats and houses in multiple occupations must include provision sufficient centrally placed bins unless provision is made for individual bins for each dwelling. There must be at least 150mm clearance around each bin.

Screening must be provided to a height of at least 450mm above the top of the bins. Consideration should also be given to providing appropriate roofing for communal bin storage areas.

Page 101 – Examples of bin storage areas.

1. Unsatisfactory examples of bin storage areas that are intrusive in the street scene
2. Examples of communal bin stores with good highway access, design and roofing.

Communal bin storage areas should be designed as an integrated part of the development and must be easily accessible to all residents, with the enclosed area provided with appropriate drainage to assist cleaning. The siting and design of communal bin storage areas should also have regard to the impact of noise and smells of neighbouring properties, existing and proposed

Selection of onsite storage systems for waste

The following table show options for waste storage and containment on site (Different types and sizes of bins and where they are utilised.

Different ways in which waste is stored. Different types of collection methods

Containers for onsite Storage systems			
Description of ways in which waste can be stored	Common Usage	Picture	Collection methods
85 litre plastic bin liners (practical limit: 10 kg / 50 litres	Domestic/ household small businesses& industry . General public facilities		By hand on site or on sidewalk full bags deposited directly
85 litre plastic/ rubber/ galvanised steel bins(practical limit on hot ash, acids and chemicals depending on materials	Domestic/ household small business & industry. General public facilities		By hand on site on sidewalk. Contents deposited directly into collection vehicle
120/ 240 litre mobile refuse bins	Domestic/ household small business & industry. General public facilities		Rear- end- loading compactors with special lifting equipment contents.

1.0 and 1.23 mobile refuse containers	Small businesses & industries, cafes, restaurants, food outlets, hotels and hostels		Rear- end- loading compactors with special lifting equipment. Specialised vehicles, front –end loaders. Contents identified.
Description of ways in which waste can be stored	Common Usage	Picture	Collection methods
4,5; 5,5;6;9& 11,0 m3 bulk containers	Large businesses & industries; garden refuse, building rubble & bulk wastes and communal collection system		Load luggers rear end-loading compactors with special lifting
15- 30 M3 open bulk containers (Check for mass limits on vehicle 3 axles	Large business & industries: garden refuse, building rubble & bulk wastes and communal collection system.		Roll on roll off vehicles
11,15 & 35 m3 closed containers	Large shopping centres, transfer stations & selected industries. Used with		Roll on roll off vehicles

SESSION 2 : TRANSPORT WASTE

LEARNING OUTCOMES :

- Waste is loaded, moved, off loaded and positioned efficiently and as required.
- Operations are carried out to quality standards efficiently and safely
- Work is carried out safely and with due care for self, fellow workers, equipment , materials and the environment.
- Incidents and problems are reported timeously and appropriate action is taken

2.1.1 Domestic waste transportation

2.1.1.1 Picture of a rear – end – loader (REL) vehicle

Pg . 106

The vehicle comes in various configurations , differing in capacity of body ranging from 11m3 to 21 M3. The smaller vehicles are equipped with single rear axles and from about 16m3 depending on road traffic regulations a second rear axle is needed to carry the excess weight. The design of the vehicle with the large rear overhang often results in overloading on the rear axles, especially when relatively empty.

Waste is loaded from the rear and compacted by a single or set of blades against the ejector blade which is a vertical blade in the loading area connected to a hydraulic ram that is used to eject the waste from the full vehicle.

When loading the ejector is pushed fully to the back. The compaction mechanism – also hydraulic- sweep the waste from the loading hopper into the body and compacts it against the ejector blade. When a certain hydraulic resistance is achieved the ejector blade automatically moves back to allow more waste to be loaded until the

total load bin is full. In this way the loose volume of the waste is reduced, depending on the type of waste, by a factor of up to five to one.

At the landfill the rear load mechanism is unlocked from the body at the bottom and lifted to allow the waste to be ejected by pushing the ejector blade to the rear.

NOTE: After offloading retract the ejector blade to prevent the long hydraulic ram from being damaged by during travelling. Arriving at the loading area move it back all the way

Other similar systems to the rear end loader is the front loader where a vehicle lifts bins from the front, transfer it over the cab and deposit the waste from the bin into a hopper area immediately at the back of the cab. A variation of the front loader is the side loader where waste is loaded into the hopper area immediately behind the cab of the vehicle. The rear end loader still remains more economical and safer than the other systems for the collection of domestic waste

1.2.1.2 The lift- on or load lugger vehicle

These vehicles , also available in single and double rear axle configuration are used for the transport of waste contained in bulk containers, typically ranging in size from 5.5m3 to 9m3.

The vehicle is fitted with rear stabilisers to prevent the front wheels from lifting when loading the bin from behind the vehicle. The vertical arms pivot to the rear and the bin is attached to chains that are suspended from the top of the arms. Pg 107.

Page 108 – starts with two pictures of trucks

When in position on the truck the bin is locked into position manually or hydraulically.

When emptying the bin, the rear locking mechanism lock the rear of the bin in position and the bin is tipped until empty, very much like a conventional tipper truck. The units can also be used to transport containers from static compactors.

1.2.1.3 The roll on roll off vehicle (Roro)

Page 109 – commences with the picture of a truck.

These vehicles are used for the transport of bins with capacities ranging from 18m3 to 30m3

Although they can only transport the same mass of load as a similar lift –on , the loading mechanism allows for bigger containers to be loaded safely. The larger volume makes it ideal for the transport of waste with a lower density like garden waste.

The bin is loaded by the arm pivoting to the rear and engaging a hook on the bin. The bin is then lifted until slides at the bottom rests on guiding wheel son the chassis. From there, the bin is rolled forward until the point where locking mechanisms lock it to the chassis

Off- loading is a reverse of the above: When emptying, the rear gate of the bin is loosened at the bottom , the rear end of the bin remains locked to the vehicle and the arm lifts the bin and pivots it so that the waste slides to the back through the rear gate.

1.2.1.4 Tractor and trailer combinations :

Tractor and trailer combinations for waste collection vary from simple and basic open trailers to complex trailer systems with compaction devices and auto offloading systems. Many of these are not suitable for inner city conditions and traffic but they have a definite place and role in waste collection in residential areas where distances to landfill sites are less than 5 kilometres and where distribution roads and streets are not in a good condition

Tractors and trailers are more robust and can handle any road surface far better than trucks. Tractors and trailers in combination is capable of providing the same load capacity as a truck and same industrial tractors can even achieve the same operating speed as trucks. Loading of trailers can be mechanised and faster loading with trailers systems have been realised than with trucks. Trucks can also be combined with trailers that use the roll on system of loading bins and can thus be easily combined with trucks that use the same system. The tractor can then do the waste collection rounds and the trucks can run the long distance to the landfill site. This approach eliminates double handling of material of a transfer station.

When distance between the collection area and the disposal site exceeds 5kms other options like combination between tractors and trailers with RORO systems through transfer stations may be the best economic alternative. The use of tractors and trailers must be included in the overall transport alternative evaluation.

Pictures of tractors and trailers (middle of page 111)

1.2.2 Vehicle Access at Developments

The following represents some guidelines of manoeuvring areas that must be allowed to facilitate waste loading at premises. If in doubt consult a transport engineer.

Nothing waste time as much as cramped turning areas , while the damage to tyres is also high when turning to sharply to often.

When selecting vehicles keep the following in mind :

- Town layout. Large vehicles have difficulty to negotiate narrow streets and especially cul de sacs.
- Topography : in hilly conditions it may be advisable to opt for automatic transmissions on the vehicles as clutches are damaged by stop- start actions. Go to a gear-box with at least five forward gears to reduce the time spent in the torque converter phase as this builds up tremendous heat and can boil the transmission oil.
- Temperature: Automatic gear boxes can be cooled by the water from the engine or directly through oil coolers exposed to air flow. In hot conditions , the latter is advisable as the double demand on the radiator to cool the engine and the gearbox often results **in** overheating of both the components.
- Clearance in streets: Cities like Stellenbosch with its historical oak trees may demand special vehicles
- Type of waste : Loose, low density waste calls for compaction to reduce the volume and optimise the chassis capacity of the vehicle. Heavy solid items need no compaction and can be transported in open vehicles.

The following table is useful in selection of alternative transport options

Picture	Description and material suitable for	Number of service points per day	Distance between collection area and disposal treatment site
	Bags carried by people. Domestic, business and light industrial waste	50- 200	0,15 -0,5km
	Person pulling or pushing carts, Street-litter, domestic, business and light industrial waste.	50- 600	1- 3 km
	Person on bicycle (3 wheels) with pull cart Light waste, recyclables	100 - 800	3-5km
	Animal drawn cart. Domestic business, industrial, builders' rubble, garden waste	200- 700	3-6km
	Tractor/ trailer (flatbed, lifted sides, special or refu-tip).	500 - 3000	4- 10 km

	Domestic Business, industrial, garden, builder's rubble		
	Flatbed trucks (low drop sides or lifted mesh sides or open sides for bales and bags) Domestic, business, industrial, garden. Waste, recyclables in bags or big bags	500- 3000 Normally linked to specific sites	5- 300km
	Delivery truck or van (totally closed with lockable rear door) Health care risk waste, special waste, radioactive waste	10- 100 linked to specific sites	5- 300km
	Tipper truck Open area dumped waste , building rubble, demolition waste, construction waste	500-2500	10- 30 km
	Load lugger (single/ double rear axles, can tow trailers) Dense waste builders rubble, sludge ash	100-3000	10-40 km
	Tip-pak truck (10- 19m3 body) domestic, business, industrial waste	500 - 3500	10- 30 km
	Rear –end loader (REL) single or double rear axle, 10,12 or 19m3body) Domestic, business, industrial garden waste	1000 - 4000	12- 30 km
	Side loader(double rear axle, 19m3 body) Domestic, business, industrial waste	1000 - 4000	12- 30 km
	Roll on roll of (double rear axle, trailer option) Domestic, business, industrial waste in compaction bins of 21, 24, 27 and 30m3 capacity. Recyclable materials compacted in bins garden and plant waste in open top containers of 18,21, 24,27, and 30m3 capacity. Builders, rubble and construction waste in open top containers	500- 9000	15- 60 km
	Train trucks for the transport of filled mass containers of 30m# capacity	7500 and more	30km and more
	Conveyers , cable ways and barges (these are specialised solutions)	Design capacity	Design capacity

SESSION 3 : Control access and monitor the flow of incoming materials to a waste facility

Learning Outcomes :

- Materials are allowed to enter the site in accordance with organisational processes
- Non – compliant waste is recognised and appropriate action is taken
- Security of the facility , equipment and resources is maintained appropriately.

1 INCOMING MATERIALS TO A WASTE FACILITY

The control of waste at waste facilities is prescribed in many ways by the minimum requirements for the disposal of waste by landfill. The following are some of the appropriate measures that must be adhered too: Appropriate measures taken at the disposal sites by landfill

Indicates how the disposal site work.

1. Signs in the appropriate official languages must be erected in the vicinity of the any waste facility, indicating the route and distance to the landfill site from the nearest main roads. These traffic signs

must conform to the requirements of the road ordinance . Suitable signs must also be erected on site to direct vehicle drivers appropriately and to control speed.

2. A general notice board must be erected at the site entrance. This must also be in the appropriate official languages stating the names addresses and telephone numbers of the permit holder and the responsible person, the hours of operation and an emergency telephone number. It is of particular importance that 3. the sign clearly states the class of landfill and the types of waste that can be accepted.

4. Waste that cannot be accepted must also be stated. It must be stated that disposal of non-acceptable waste types is illegal and can lead to prosecution. In the case of hazardous waste landfills, 5. clearly visible signposts warning of the associated hazards must be erected along the fence line at intervals not exceeding 100m.

1.3.2 Waste Acceptance (Purpose of waste classification – Waste should be received at sites where it supposed to be deposited/ received.

One purpose of waste classification of waste facilities is to ensure that general waste is only received at sites suitable for such material and that any problematic material or hazardous is disposed of only on sites and facilities especially designed and developed for hazardous material.

Prior to waste being accepted at general waste facilities, it must be inspected by suitably qualified staff and the transporter must confirm that it is general waste. In the case of doubt , any industrial waste should be considered as potentially hazardous until proven otherwise and directed to a suitable disposal facility or testing facility.

The operator of the working face must make sure that no hazardous waste (e,g. Hazardous liquids, sludge, solids or even sealed drums) are disposed of. Such controls are particularly important at general waste landfill sites in the vicinity of industrial areas. In the event of hazardous waste being intercepted at a general waste landfill site, it must be diverted to a hazardous waste landfill site. The source , vehicle registration and a description of the waste must be reported immediately to the Department of Environmental Affairs.

1.3.3 Access Control (how access into a landfill / disposal site is controlled?)

In order to facilitate the above waste acceptance procedures, access to the site must be controlled. It is therefore required that vehicle access to a site be limited to a single controlled entrance to prevent the unauthorised entry and illegal dumping of waste on the site.

The site entrance must comprise a lockable gate which must be manned during ours of operation. Additional security , after operating hours , is required at all hazardous waste disposal sites, and general waste disposal where appropriate.

1.3.4 Collection of disposal tariffs

In most cases, waste disposal tariffs are levied and collected at all waste facilities. Tariffs should be displayed on the notice board. They should be based on the mass where a weigh bridge exists, on estimated volumes.

1.3.5 Security

In addition to access control, suitable security must be provided to protect any facilities and plant on site. Any site of facility where equipment is stored overnight requires 24 hour security 7 days per week. Provision for safety and protection of security is required to ensure that the security guards are protected against the natural elements.

Un authorised pedestrian access must be strictly prohibited at hazardous waste disposal sites, although this may be difficult in some instances. Perimeter fencing is the standard approach to control pedestrian access. People who live from recovery of material from waste however tend to damage fences and may even stay within the boundary of the site or facility. The owner and permit holder for a site is the final responsible person for safety and security at a site and any person that is injured or hurt at a site may claim against the owner or permit holder or operator on site, even if the person is illegally picked material from the site or facility**.**

SESSION 4 : RECOGNISE AND REPORT THREATS OR DAMAGE TO HEALTH , SAFETY OR THE ENVIRONMENT.

Learning outcomes

- Potential dangers to health, safety and the environment which can arise during the processes of handling , separating, treating , storing and transporting waste are identified and described accurately and appropriately.
- Measures which can be taken to prevent, correct, or remedy threats or damage to health, safety, or the environment are explained correctly.

Every facility should have an operating plan with a response action plan

It should be operated in accordance with an operating plan for the site.

The response plan should be developed according to clear stipulations in the operation plan

It should be clear on the types of materials accepted in the facility

Procedures and processes to be followed for the operation of the facility

Procedures and processes to be followed in terms of accidents emergencies, failures in the design or operation.

All failure modes and effects must be quantified in a risk assessment and on site and offsite emergency plans developed. These plans require evacuation drills and staff must be familiar with the different plans and drills for each of these plans.

Every waste facility is operated in accordance with an operating plan which is supplemented by a response action plan. The operating plan is developed in accordance with stipulations and rules contained in the operational permit for the site. The operational permit is clear and specific regarding the types and classes of material that may be accepted at the specific facility. It is also clear and specific regarding allowable processes and procedures for the operation of the facility.

The response action plan provides detail of procedures to be followed in case of accidents, emergencies, failures in the design or operation. It also includes an emergency evacuation plan.

All failure modes and effects must be quantified in a risk assessment and on site and offsite emergency plans developed. These plans require evacuation drills and staff must be familiar with the different plans and drills for each of these plans. Military precision is required for these plans and no deviation should be allowed.

Training of staff and practice drills of procedures is of core importance to ensure that all staff knows exactly what to do in case of emergencies.

Control of Nuisances:

Any facility that receives waste material will experience mishaps and this will result in nuisances. These should however be the exception and not the rule. With accidents and similar incidents nuisances may be more frequent and procedures to handle these are required. Nuisances resulting from the operation should be controlled as follows:

Nuisances resulting from the operations: burning of waste, litter, odours, noise, **Vermin and disease carrying vectors, 6 Dust and Mud, Illegal recovery of material from waste, Uncontrolled material separation and recovery**

How the nuisances can be controlled:

1.4.1.1 Burning of Waste

The burning of waste is considered unacceptable because of aesthetics, odours, and the potential of health dangers from air pollution. On account of these adverse impacts, the burning of waste at waste facilities is prohibited; this should be applied to all areas and activities where waste occurs, is generated or is handled,. The only exception should be controlled burning through proper incineration or other heat treatment processes. Accidental fires on waste facilities must be extinguished immediately. Fires at landfill sites often thrive on the presence of methane gas and specialised operations for extinguishing such fires as required**.**

1.4.1.2 Litter

All litter must be contained within the site . On sites characterised by high winds , however movable litter fences may be a requirement. Windblown litter must be picked up and removed from fences and vegetation on a daily basis. Litter picking must be extended to the perimeter of the site and to the access roads into the site or facility.

1.4.1.3 Odours

Odours must be prevented by handling waste in such a way that odours are contained as soon as possible Immediate spreading and covering of waste is one of the best approaches to eliminate odours. In some cases spraying of the site or facility to eliminate or reduce the odour level may be required. The standard should however be to handle material with odours or potential odours as quickly as possible and to cover it with a layer of soil after it was placed at the correct place

1.4.1.4 Noise

All equipment used on site must conform to standard noise level controls or to the local authority's by laws concerning noise levels. Hours of operation must be adhered to and work after hours must be limited or avoided to ensure that noise after hours do not occur. In the absence of bylaws, national regulations on noise control must be complied with.

1.4.1.5 Vermin and disease carrying vectors

Waste sites must kept free of vermin. To ensure this traps and bait must be placed at safe and strategic places or other natural and more humane procedures to control rats and mice must be deployed. Appropriate measures must be taken to eliminate or minimise disease vectors such as rats or flies. Any possible breeding or nesting place or site must be eliminated. This includes places where water accumulate like in old tyres, protection against nature to vermin, and waste that is left uncovered to allow vermin to enter, feed and nest in the waste.

1.4.1.6 Dust and Mud

Dust would occur at waste facilities when dry material is handled or received. Roads to the site and on the site will also generate dust especially from dirt roads , when vehicles travel on them. Special control procedures like watering during dry seasons and times would reduce the amount of dust generated and thus the nuisance effect thereof. Too much water would however cause mud and dirty vehicles. The mud can be transferred to adjacent roads and course nuisances to road users not visiting the site

1.4.1.7

Illegal recovery of material from waste

Visitors to waste facilities often pick goods and stuff from the site. This should not be allowed and proper control of the work front and at the entrance and exit gate is required to control the illegal recovery and removal of goods from the waste facility. In principle the material belongs to the owner/ operator of the waste facility and any material illegally recovered and removed from the site is similar to theft from any other facility.

1.4.1.8 Uncontrolled material separation and recovery

Uncontrolled material separation by individuals other than people who enter site to dispose or offload material should not be allowed as well. These people often harass the members of the public who visit the site to offload waste and then the people who separate material flock the vehicle, jump onto it and take over as if the vehicle belongs to them. They have no respect for the owner/ visitor and they create an illusion of no control, no operational standards, no rules and no system. The public does not like this and it is the duty and obligation of the owner/operator to stop these activities and create a controlled and coordinated waste separation process and system.

SESSION 5

COMPILE RELEVANT RECORDS

Learning Outcomes:

- **Records are completed accurately, up to date and processed correctly**

Waste site operators , facility users and the Department of Environmental Affairs all require waste records for different reasons. Over and above the measurement of incoming waste for commercial purposes , records are also necessary for site management and control. Normal business requirements also require that records of waste process and related activities be generated and maintained. The following is a list of key activities that require recording:

Gate or weighbridge recording procedures:

The primary source of information is the entrance gate or weighbridge. The method of waste recording must be appropriate to the nature and the volume of the wastes entering the site. Such data bases are sometimes termed dynamic records. The degree of sophistication required will be dependent on the class of site involved. In general , however records must be kept of all waste entering the site.

Weighbridges are expensive and costly to operate and are normally only introduced for sites and facilities where large volumes of waste are received. For smaller facilities volume control is adequate, but then the volumes must be as accurate as is practical possible, like measuring the size of a load rather than estimating the size. Waste must be categorised by the number of loads(defined by volume or mass) the type of waste and the source.

Material separation: Any facility where waste is separated from the waste stream requires recording of the type and the volume or mass of material separated. The records should reflect separated material in terms of the different classes of material e,g the different types of metal, types of plastic, types of paper, and carton, types of glass and other material recovered. A scale to weigh the mass of separated material is required since all separated material are sold per mass**.**

Garden waste processing:

Garden waste and any other material of plant origin should be composted to enable return into the life cycle of plants and life. Other material like abattoir waste can be composted with the plant material. Processing of garden waste begins with chipping of material into smaller particle size . After chipping of the material it is mixed with other material like abattoir waste and composting agents to encourage the breakdown process.

Composting is a science in its own right and requires regular monitoring and turning of the material that is composted. This encourages the flow of air through the material. The moisture content must also be monitored to avoid the material from drying since dry material would not decompose and turn into quality compost.

Handling of special waste:

Special waste received include standard household chemicals and containers used batteries and other electronic equipment like old cell phones and remotes, household appliances and used computers, used machines and equipment, used and old furniture, used carpets and other bulky material and goods. Special provision for the handling of such waste is required at waste facilities. The provision must include proper and accurate recording of the type and nature of the material and the person who disposed the material.

Equipment and Resource use :

Use of equipment and resources is part of every operation. The type of equipment used and the duration of use for every piece of equipment are required. In addition the specific use of equipment must be recorded. Stating that a tyre cutter was used is not enough, indicate the time it was used, the number of tyres that was cut, the volume of fuel that was used, and the maintenance that was required to keep it running. This information is required to determine the productivity of the tyre cutting machine and of the team that operates the tyre cutter.

Similar information is required for all equipment and machines use on the site or facility , information about the staff deployed with each machine is also required for the calculation of the productivity.

Safety health and security:

Safety and health at work is the responsibility of every staff member and it begins at the employees ' work place. Keep the area tidy, put things that are not used away, complete the tasks and get the completed tasks dispatched to the specific destination, keep the floor area tidy, when you carry things make sure you can see where you are going, rather use trolleys to move heavy or big objects or articles, make sure that electrical cables is out of the way and would not cause people to trip over them. Any tools that are used must be stored or stowed in the correct and safe way to guard against injury.

Security is also the responsibility of every individual . Employees must ensure that any equipment that was used is returned to the appropriate storage area and that it is entered into the record books of returned goods. It is expected from employees to ask visitors to where they are going and to ensure that visitors do not enter the prohibited and especially high security and dangerous areas. This must be done in a friendly and polite manner. Greet the visitor to the destination and if it is the same area or region where you are going offer to guide the visitor to the specific site or destination.

If visitors are picking material from any area on the site, the action must be reported immediately to the supervisor and relevant control persons like security guards. The visitor can be addressed in a friendly manner to indicate that the person may not pick stuff and remove it from the site or facility.

Any visitor entering a restricted area must be stopped for the safety and security of the visitor and of the organisation. Visitors injured on a site can lead to claims against the company but the visitor may also be part of a plot to sabotage the organisation. This is a critical aspect of security and all staff must be part of the control process to ensure integrity of security on the site.

Weather

Waste disposal facilities require weather recording. This is needed for planning and control purposes. Wind strength and direction is needed to identify the potential influence of odours on neighbouring properties, rainfall is measured with a rain gauge and is used to determine the amount of water that enters the waste and the work area, wet bulb and dry bulb temperature readings provide information about the relative humidity and with atmospheric pressure records some prediction of weather changes is possible. Highest and lowest temperatures for the day is handy extra information but not that critical for waste facilities. A basic weather station for waste facility would include at least wind direction and strength measurement , rain gauge and relative humidity recording.

Accidents, incidents and emergencies.

Records of all incidents at a waste facility must be compiled and kept for future use and reference. Accident reports must be kept on site and at the head office of the organisation. No accident must be ignored irrespective of the damage or the impact to the property or injury to people involved in the accident. It is the duty of every person working on a site to report accidents and incidents without exception. The same applies to any emergency situation like bad weather, illegal access, illegal removal of material or goods from the site, electricity breakdown or outages, water.

Appendix 14: Types of Knowledge identified in PROVIDER 2's Materials for UNIT STANDARD 1: Separate, handle, store, treat, and transport waste

Specialised Knowledge / scientific knowledge				**Values**	**Planning & management**
Outcomes					
Propositional	**Procedural**	**Technical**	**Legal**	**Values**	**Planning & management**
also Know and understand: Principles and concepts related to waste management and	Methods of handling and transporting waste and Skills **knowledge**	**Their application of** principles and concepts related to waste **in practice**	Classify separate , treat and transport waste safely, responsible and in compliance with legislation	**values reflected will**	
Propositional	**Procedural**	**Technical**	**Legal**	**Values**	**Planning & management**
SESSION 1 : Separate, treat, and store waste.					
Outcomes					
Waste is separated into various categories and processed appropriately	Handling , treatment and storage methods are selected and applied for each category and waste correctly	Chemical, physical , biological methods of treating waste	Incidents and problems related to waste handling, storage and treatment are discussed and explained appropriately and accurately	Work is carried out safely and with due care for self, fellow workers, equipment , materials and the environment	Environmentally damaging practices are recognised and reported timeously and accurately
Separate and treat					
Recyclable material for the purpose of recycling must not be stored at any premise resulting in risks or nuisance conditions: Composting of garden waste Where applicable arrangements should be made in the development of flats to facilitate the onsite composting of materials from the maintenance of communal	Separation of waste or sorting of recyclables shall be performed on the premises, of the point of generation of the recyclable waste stream Glass recycling: municipalities as part of the domestic waste and recyclable materials collection service and must normally be taken to glass recycling banks. Communal waste storage	Principles and concepts related to waste management and their application in practice	All persons involved in any way in recycling , must comply with all applicable statutory requirements All facilities where separation and classification of recyclables material is performed , must comply with applicable statutory requirements.	Care for self, fellow workers , equipment, materials and the environment	Poor Planning issues around accommodation of bins can result in problems namely: accommodating refuse bins in the layout and design of a development a number of issues can arise: The bins can be prominent and intrusive in the street scene ,particularly in developments at higher densities. Where housing is situated close to, or on the back

grassed areas and shrub planting The appropriate positioning bin for grass cuttings and chipped woody material yo provide compost for reuse on site would save transport and disposal costs for grounds maintenance contractors Specifications for places where waste is stored. The floor shall be concrete , screened to a smooth surface and rounded to a height of 75mm around the perimeter. The floor shall be graded and drained to a floor trap. Floors and roof. The waste/ recycling storage are / room shall be roofed to prevent any rainwater from entering. The walls shall be constructed of brick , concrete or similar and painted with light colour high gloss enamel , or alternatively , tiled with tiles of a light colour. The height of a room to the ceiling shall be	facilities installed , are normally encouraged to make additional provision within the bin storage area to accommodate three bins for clear, green and brown glass. Careful consideration need to be given to the positioning and screening of glass recycling facilities to ensure that noise and disturbance in minimised. Water supply and Drainage A tap with minimum 12mm diameter standard hose connection shall be provided in the waste/ recycling storage area/room for washing containers and cleaning spillage: Residential areas Offices Retail Hotels Screening and security Compaction equipment. Access				edge of the footway or pavement , bins can be left obstructing the pavement. Bin storage areas can be inconveniently located for residents or in accessible to refuse collection crews; Bin storage areas that are poorly sited and designed can result in a loss of amenity for residents due to noise and odour.

not less than 2.21 metres. Ventilation and lighting The waste /recycling storage area/room shall be adequately ventilated by means of fixed glass louvers. Different types and sizes of bins and where they are utilised. Different ways in which waste is stored. Different types of collection methods					
Session 2: Transport Waste					
Propositional	**Procedural**	**Technical**	**Legal**	**Values**	**Planning & management**
Outcomes: Waste is loaded, moved, off loaded and positioned efficiently and as required.			Operations are carried out to quality standards efficiently and safely	Work is carried out safely and with due care for self, fellow workers, equipment, materials and the environment.	Incidents and problems are reported timeously and appropriate action is taken
Transport Waste					
Types of waste transportation Domestic waste transportation Types of vehicles used Description of each and every vehicle used As well as how it works e,g Waste is loaded from the rear and compacted by a single or set of blades					

against the ejector blade which is a vertical blade in the loading area connected to a hydraulic ram that is used to eject the waste from the full vehicle. Examples of vehicles: Rear – end – loader vehicle (REL The lift- on or load lugger vehicle 3. The roll on roll off vehicle (Roro) 4 Tractor and trailer combinations : Things to be taken into consideration while choosing vehicles for transporting waste Town layout Topography Temperature Clearance in streets Types of waste Examples of alternative waste transportation vehicles Bags carried by people Person pulling or pushing carts, Street- litter, domestic Person on bicycle (3 wheels) with pull cart Light waste, recyclables					

Animal drawn cart. Domestic business, industrial, builders' rubble, garden waste Tractor/ trailer (flatbed, lifted sides, special or refu-tip).					
Session 3: Control access and monitor the flow of incoming materials to a waste facility					
Propositional	**Procedural**	**Technical**	**Legal**	**Values**	**Planning & management**
Outcomes					
Materials are allowed to enter the site in accordance with organisational processes Non – compliant waste is recognised and appropriate action is taken Security of the facility, equipment and resources is maintained appropriately It is of particular importance that the sign clearly states the class of landfill and the types of waste that can be accepted. Waste that cannot be accepted must also be stated. It must be stated that In the case of hazardous waste landfills, Clearly visible signposts	Suitable signs must also be erected on site to direct vehicle drivers appropriately and to control speed. A general notice board must be erected at the site entrance. This must also be in the appropriate official languages stating the names addresses and telephone numbers of the permit holder and the responsible person, the hours of operation and an emergency telephone number A general notice board must be erected at the site entrance. This must also be in the appropriate official		Non – compliant waste is recognised and appropriate action is taken Waste that cannot be accepted must also be stated. It must be stated that disposal of non-acceptable waste types is illegal and can lead to prosecution. In the case of hazardous waste landfills Disposal of non-acceptable waste types is illegal and can lead to prosecution.		

warning of the associated hazards must be erected along the fence line at intervals not exceeding 100m. Classification of waste: One purpose of waste classification of waste facilities is to ensure that general waste is only received at sites suitable for such material. And problematic material or hazardous is disposed of only on sites and facilities especially designed and developed for hazardous material. Un authorised pedestrian access must be strictly prohibited at hazardous waste disposal sites, although this may be difficult in some instances. People who live from recovery of material from waste however tend to damage fences They may stay within the boundary of the site or facility.	languages stating the names addresses and telephone numbers of the permit holder Prior to waste being accepted at general waste facilities, it must be inspected by suitably qualified staff and the transporter must confirm that it is general waste. In most cases, waste disposal tariffs are levied and collected at all waste facilities. Tariffs should be displayed on the notice board. They should be based on the mass where a weigh bridge exists, on estimated volumes In addition to access control, suitable security must be provided to protect any facilities and plant on site. Perimeter fencing is the standard approach to control pedestrian access .				
Session 4	RECOGNISE AND REPORT THREATS OR DAMAGE TO HEALTH, SAFETY OR THE ENVIRONMENT				

Outcomes:					
Propositional	**Procedural**	**Technical**	**Legal**	**Values**	**Planning & management**
Potential dangers to health, safety and the environment which can arise during the processes of handling , separating, treating , storing and transporting waste are identified	Measures which can be taken to prevent, correct, or remedy threats or damage to health, safety, or the environment are explained correctly.				
Every facility should have an operating plan with a response action plan It should be operated in accordance with an operating plan for the site. The response plan should be developed according to clear stipulations in the operation plan It should be clear on the types of materials accepted in the facility Procedures and processes to be followed for the operation of the facility Procedures and processes to be followed in terms of accidents emergencies, failures in the design or operation. All failure modes and effects must be quantified in a	The burning of waste is considered unacceptable because of aesthetics, odours, and the potential of health dangers from air pollution. On account of these adverse impacts, the burning of waste at waste facilities is prohibited Accidental fires on waste facilities must be extinguished immediate All litter must be contained within the site On sites characterised by high winds , however movable litter fences may be a requirement. Windblown litter must be picked up and removed from fences and				Every facility should have an operating plan with a response action plan It should be operated in accordance with an operating plan for the site. The response plan should be developed according to clear stipulations in the operation plan It should be clear on the types of materials accepted in the facility Procedures and processes to be followed for the operation of the facility Procedures and processes to be followed in terms of accidents emergencies, failures in the design or operation. All failure modes and effects must be quantified in a risk assessment	

risk assessment and on site and offsite emergency plans developed. These plans require evacuation drills and staff must be familiar with the different plans and drills for each of these plans With accidents and similar incidents nuisances may be more frequent and procedures to handle these are required Nuisances resulting from the operations: burning of waste, litter, odours, noise, Vermin and disease carrying vectors, 6 Dust and Mud, Illegal recovery of material from waste, Uncontrolled material separation and recovery Uncontrolled material separation by individuals other than people who enter site to dispose or offload material should not be allowed as well. These people often harass the	vegetation on a daily basis. Litter picking must be extended to the perimeter of the site and to the access roads into the site or facility. **Odours** possible Immediate spreading and covering of waste is one of the best approaches to eliminate odours. In some cases spraying of the site or facility to eliminate or reduce the odour level may be required Noise Pollution All equipment used on site must conform to standard noise level controls or to the local authority's by laws concerning noise levels. Waste sites must kept free of vermin. To ensure this traps and bait must be placed at safe and strategic places or other natural and more humane procedures to control rats and mice must be deployed Dust &Mud				and on site and offsite emergency plans developed. These plans require evacuation drills and staff must be familiar with the different plans and drills for each of these plans	

members of the public who visit the site to offload waste and then the people who separate material flock the vehicle, jump onto it and take over as if the vehicle belongs to them.	Special control procedures like watering during dry seasons and times would reduce the amount of dust generated and thus the nuisance effect thereof. This should not be allowed and proper control of the work front and at the entrance and exit gate is required to control the illegal recovery and removal of goods from the waste facility					
SESSION 5: COMPILE RELEVANT RECORDS						
Propositional	**Procedural**	**Technical**	**Legal**	**Values**	**Planning & management**	
Outcome : Records are completed accurately, up to date and processed correctly						
Waste site operators , facility users and the Department of Environmental Affairs all require waste records for different reasons. Records are also necessary for site management and control.	a list of key activities that require recording: Gate or weighbridge recording procedures for big facilities For smaller facilities volume control is adequate, but then the volumes must be as accurate as	Composting is a science in its own right and requires regular monitoring and turning of the material that is composted. This encourages the flow of air through the material	Waste site operators , facility users and the Department of Environmental Affairs all require waste records for different reasons.		Employees must ensure that any equipment that was used is returned to the appropriate storage area and that it is entered into the record books of returned goods	

Normal business requirements also require that records of waste process and related activities be generated and maintained	is practical possible, like measuring the size of a load rather than estimating the size. Material separation and waste separated need to be recorded Recording need to be done per type and the volume or mass of material separate The records should reflect separated material in terms of the different classes of material e,g types of metal, types of plastic, types of paper, types of glass and other material recovered Garden waste processing: Garden waste and any other material of plant origin should be composted to enable return into the life cycle of plants and life. Special provision for the handling of such waste is required at waste facilities. The provision must include proper and accurate recording of the type	**Handling of special waste:** Special waste received include standard household chemicals and containers used batteries and other electronic equipment like old cell phones and remotes, household appliances and used computers, used machines and equipment, used and old furniture, used carpets and other bulky material and goods Equipment and Resource use Use of equipment and resources is part of every operation. The type of equipment used and the duration of use for every piece of equipment are required. The specific use of equipment must be recorded Safety health and security: Safety and health at work is the responsibility of every staff member and it			

	Weather Waste disposal facilities require weather recording. This is needed for planning and control purposes Accidents, incidents and emergencies. Records of all incidents at a waste facility must be compiled and kept for future use and reference. Accident reports must be kept on site and at the head office of the organisation. No accident must be ignored irrespective of the damage or the impact to the property or injury to people involved in the accident.	begins at the employees' work place. Security is also the responsibility of every individual. Employees must ensure that any equipment that was used is returned to the appropriate storage area and that it is entered into the record books of returned goods If visitors are picking material from any area on the site, the action must be reported immediately to the supervisor and relevant control persons like security guards Any visitor entering a restricted area must be stopped for the safety and security of the visitor and of the organisation.			