Learning pathways for improving rehabilitation practices in the mining industry: two cases of coal mining and borrow pits

Thesis submitted in fulfilment of the requirements of the Degree of Masters in Environmental Education

Rhodes University

By

Andani Mphinyane

G11M5653

Supervisor: Professor Heila Lotz-Sisitka

February 2013

ABSTRACT

"As we move into a knowledge society, with its emphasis on knowledge building, it is *'learning'* that becomes more and more important. 'Workplace learning' is a key part of this, driven by the impact of changes in demographics, skills demands, technologies, and people's relationships and roles within various institutions and communities" (Vaughan, 2008, p. 1).

This research investigates cases of learning pathways for improving rehabilitation practices for key occupations in the mining industry. The study is set up as a partnership research programme between Rhodes University Environmental Learning Research Centre in South Africa, and the South African Qualification Authority, focussing on workplace learning and sustainability practices. This research programme seeks to understand the implications of the move to a knowledge society, with its emphasis on knowledge building over time, particularly in and for the environmental sector.

The research was conducted as a qualitative case study that made use of semi-structured interviews, document analysis, visual photographs and observations as instruments of data gathering. Participants were sampled from two case studies, one in Limpopo province and the other one in Mpumalanga Province, who are directly involved in rehabilitation practices and related education and training programmes. The study makes use of career stories from the key occupations to provide insight into workplace learning pathways to inform education and training in the mining industry. A series of analytical statements captures some of the main findings on early education histories, career choices, learning pathway decisions and experiences related to sustainable practices and some complexities related to learning pathways. Environment and sustainability education is a cross-cutting issue in the NQF; and it pertains to the mining sector, especially to rehabilitation practices, which form the focus of this study as little is known about learning pathways associated with these sustainability practices. Insights from the study should enable the sector to enhance rehabilitation training for key occupations and at the same time encourage lifelong learning contributing towards sustainable development.

ACKNOWLEDGEMENTS

This dissertation would not have been possible without the guidance and the help of several individuals who in one way or another contributed and extended their valuable assistance in the preparation and completion of this study.

I would like to take this opportunity to thank the South African Qualification Authority for providing funding to support this research study at Rhodes University.

I would also like to extend and convey my sincere gratitude to the following individuals who contributed to this thesis, each in their unique way:

- My supervisor: Prof. Heila Lotz-Sisitka for her academic support and guidance in putting this work together and my co-supervisor Prof. Rob O'Donoghue. I have learnt a lot from you. I respect you.
- My parents, M.S Mphinyane (father) and D.G Mphinyane (mother) for their countless forms of moral support.
- To my colleague Nthabiseng and 'my uncles', Clayton and Charles, your words of encouragement and confidence in me and to the entire Environmental Learning Research Centre staff.

My greatest thanks go to the Mbuyelo Mining Contractors for allowing me to conduct the research and providing me with recent data in relation to rehabilitation practices. Last but not least goes to Rhodes University for giving me a great opportunity to further my studies.

ACRONYMS

SAQA	**South African Qualification Authority**
NQF	**National Qualification Framework**
NEMA	**National Environmental Management Act**
DEA	**Department of Environmental Affairs**
SETA	**Sector Education and Training Authority**
ESSP	**Environmental Sector Skills Plan**
RSA	**Republic of South Africa**
MQA	**Mining Qualification Authority**
SGB	**Standard Generating Body**
EMP	**Environmental Management Plan**
EIA	**Environmental Impact Assessment**
SHE	**Safety Health Environment**
QCTO	**Qualification Council for Trade and Occupations**
CHE	**Council for Higher Education**
DHET	**Department of Higher Education and Training**
DoL	**Department of Labour**
HSRC	**Human Scientific Resource Council**
CSIR	**Council of Scientific and Industrial Research**
AMD	**Acid Mine Drainage**
MMS	**Mining and Mineral Sector**

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

BACKGROUND INFORMATION

1.1 Introduction of the study

In this chapter I introduce the context, interest and also the development of the study bearing in mind my past involvement with the mining industry. To fully elaborate and describe the context of the study (key occupations), I start with a discussion on what the South African Qualification Authority has been working on in order to improve the education and training programmes at workplace environments which is the core focus of this research study. I also introduce the broader context of the study sites, a case study of borrow pits and coal mining. The discussion goes on to depict the research questions. Finally, I provide a descriptive overview of the study using research languages that report my work to the reader.

1.2 Research interest and development of the study

The development of this research has been motivated by several factors. Individuals such as environmentalists, GIS specialists, engineers and biotechnology researchers (amongst others) have invested time and resources to find effective ways of improving rehabilitation practices in the mining industry. Little is, however, known about *how people come to learn to implement and improve these practices, especially in South Africa where these practices are relatively new, and knowledge of learning pathways is still unclear* (Lotz-Sisitka, 2010). To make matters more complex, different rehabilitation practices require different knowledge, skills, values and types of work experience.

Having being involved in the social facilitation and some of the environmental services provided by consultants working with mines, I developed an interest in researching education and training in the workplace environment for certain key occupations at

managerial level. Much more influence came from what I was seeing in my everyday life in the community where there were many abandoned borrow pits which were left unrehabilitated.

1.3 The SAQA and NQF

The South African Qualifications Authority (SAQA) has formed a research partnership with Rhodes University to undertake collaborative research on change oriented learning and sustainability practice learning systems to inform future directions of education and training in South African workplace environments (Lotz-Sisitka, 2010). One of the issues that the research programme is seeking to understand is the implication of the move to a knowledge society, with its emphasis on knowledge building over time, particularly in and for the environmental sector. Recent research conducted for South Africa's Environmental Sector Skills Plan (ESSP) shows that in this trajectory, career path development becomes a more and more important factor in and for the environmental sector (DEA, 2010).

This research aims to deepen the understanding of educational responses to contemporary risk and vulnerability in South Africa, particularly in the mining sector. As implementation of NQF seeks to integrate education and training for all sectors of South African industries, this study hopes to provide perspective on learning pathways in the mining sector promoting economic growth within a sustainable development paradigm (Ensor, 2003). Over time, environmentalists and educators and other various bodies have promoted the need to do more than simply raise awareness about issues relating to rehabilitation and sustainability practices or provide trainees with adequate experiences (O'Donoghue, Rosenberg & Olvitt, 2008; DEA, 2010). They stress that particular training methods can address this rehabilitation problem in the mining and other industries and that these need to be seen as a broader frame of workplace learning pathways relevant to sustainability practices to address a spectrum of environmental learning outcomes (ibid., Lotz-Sisitka, 2010).

One of the challenges facing SAQA in its new role after promulgation of the new NQF Act (RSA, 2008) is the establishment of clear pathways to link three sub-frameworks which influence South African industry and workplace learning contexts. On the issue of NQF to support career pathways in the industrial sectors Ensor (2003) outlined that the NQF was

devised in the first instance to meet the particular problems facing the industrial sector, but was rapidly extended to encompass the whole education and training spectrum. These are the schooling and FET college sub-framework (Umalusi); the trades occupations and education sub-framework (Qualifications Council for Trade and Occupations-QCTO); and the higher education sub-framework (CHE). In the case of the mining industry, it is likely that senior personnel involved in rehabilitation practices would have a higher education qualification, but would also need to undertake 'in-service' training to update themselves on new environmental legislation or on new types of rehabilitation practices. Thus, their learning pathways would cross the NQF sub-frameworks. I am interested in finding out if such a situation exists, and if so what enables or constrains the crossing of the subsystem of the NQF as people in key occupations develop a learning pathway that allows them to improve their knowledge, skills and values for improved rehabilitation practices.

The Mining Qualification Authority (MQA) is a statutory body that was established in terms of the Mine Health and Safety Act (No. 29 of 1996, RSA 1996) and that is also registered as a Sector Education and Training Authority (SETA) for the Mining and Minerals Sector (MMS) in terms of the Skills development Act (No. 97 of 1998, RSA 1998). The MQA also houses the Standards Generating Body (SGB) for the MMS and is therefore responsible for the generation and revision of unit standards and qualifications. The MQA and the environmental education standards generating body (SGB) have written a number of standards that have been registered and are now available on the NQF.

I chose to focus my research on learning pathways of key occupations in the mining industries with a specific focus on rehabilitation practices and how they are learned, because of my previous involvement with the mining industries as a mining and environmental geologist. In this role I noticed that a number of social and environmental issues related to training while working as a freelance consultant, among these were; induction training, availability of competence certificates, shortage of skills, lack of support on education and training and inconsistent workplace learning related to such practices. In this work, I came across a number of challenges that have led to the research interests that I describe in this section.

The purpose of learning pathways is well described in SAQA's Draft Level Descriptors document (SAQA, 2001, p. 52). SAQA (ibid.) describes the interface between learning and working, and its interest in learning pathways as follows:

> The idea of a learning or career pathway may convey the notion of a linear progression through the education or job hierarchy respectively. Quite rightly, from the outset the design of the South African NQF has been based on a non-linear progression model that reflects the varied nature of individual learning and career choices, especially in the current era of rapid knowledge growth and occupational change. The concepts of articulation and mobility have been built in to the NQF progression model because learners and workers need to be able to exercise their options to move vertically, horizontally or diagonally between learning or career pathways as the case may be, with due credit for learning achieved. The idea of a pathway as embodying an organised sequence of connection or switching points is more appropriate to our circumstances.

This research will also seek to deepen insight into accessibility of specific skills areas (rehabilitation practices) as a major factor in workplace churn is a lack of development opportunities or visible training programmes that will help enhance job skills. This has been identified as hampering rehabilitation practices in the mining industry (Wright, 2008). Wright (ibid) further expands on the matter of absences of accessibility as he outlines that sometimes development opportunities *do* exist within the industry, but are not easily accessible or visible to employees. Hence visible, easily accessible and well planned *learning pathways* that can act as a stream of knowledge and development within the industrial sector are not always realised.

1.4 Broader context of the two rehabilitation practices and the study sites

South African legislation governing mine closure, particularly the Mineral and Petroleum Resources Development Act (28 of 2002, RSA 2002), requires rigorous mitigation of both biophysical and socio-economic impacts. Before this Act, closure was governed by the Minerals Act (Act 50 of 1991). The Minerals Act provided a basis for environmental management for the first time, and prior to its passing into law, many mining companies "used irresponsible mining methods with no regard towards protecting the environment and had often shirked their responsibility towards environmental rehabilitation by leaving

an area unrehabilitated prior to them being liquidated or leaving the country" (Swart, 2003, p. 3).

The debate surrounding rehabilitation practices in the mining industry is a drawn-out one, which has long gained considerable attention from a wide range of parties. The safety, environmental and social risks arising from badly conducted mine closure can result in significant liabilities for mining companies. For communities, closure can cause severe distress because of the threat of economic and social collapse. Abandoned mines may result in large clean-up costs and closure liabilities for governments (World Bank, 2002).

Diversity of species is a key characteristic of natural ecosystems. These ecosystems, in turn, form the basis of all ecosystem goods and services upon which sustainable livelihoods and food security depend. Historically, the mining sector has not recognised this, and mining activities have often resulted in destruction of or radical alterations to whole ecosystems. In such cases, full recovery of these ecosystems and their components may take many years, possibly even millennia (Cooke, 1999). Consequently, the impacts on the biophysical environment caused by the mining and minerals processing industry have frequently been accompanied by a significant loss of biodiversity. This may pertain even when a mine is rehabilitated after closure. Current best practice attempts to avoid negative impacts and, where necessary, to restore impacted environments. This is an essential step if the sector is to contribute significantly towards sustainable development in the region (Hoadley, Limpitlaw & Weaver, 2002).

The development of this research has been motivated by several factors. Individuals such as environmentalists, GIS specialists, engineers and biotechnology researchers (amongst others) have invested time and resources to find effective ways of improving rehabilitation practices in the mining industry. As indicated above little is known about *how people come to learn to implement and improve these practices.* It is also necessary to understand the knowledge, skills and values needed for such practices to understand learning pathways. I briefly overview each of the two practices that I intend to use as foci for the learning pathways research below to illustrate this.

1.4.1 Rehabilitation of borrow pits

In the late 2009 and 2010 I became involved in rehabilitation practices for borrow pits at my cousin's consulting company, providing environmental services which included EIA, EMP, induction training etc. One of our main aims and purposes was to document the rehabilitation closure activities and provide a report back on findings of the site visit/inspection followed by the scope of closer actions implemented for rehabilitation of the borrow pit sites (SHE, 2010). Mine site rehabilitation, unlike farmland rehabilitation often deals with extreme situations (Gilbert, 2000). A borrow pit is a place where earth is taken but never replaced. In broad terms the rehabilitation of borrow pits includes the grading and reshaping of the slopes of pits. Rehabilitation of this small scale mining is through strengthening of environmental enforcement and involvement of various initiatives such as the Minerals and Petroleum Resources Act and its supporting regulations, the development of mine environmental management, the finalisation of site inspection and the strategies for mine closure.

1.4.2 Rehabilitation practices on coal mining

The coal mining sector will continue, by the very nature of its activities, to drive environmental change, notwithstanding the environmental guidelines, education and training, legislation and substantial impact mitigation and management measures developed to address many of the adverse environmental affects described in this research report. An important challenge facing the mining sector is to embrace the concept of sustainable development and, in doing so, improve public perceptions, particularly with regards to social and environmental issues of concern.

This research seeks to offer a useful tool under the umbrella of environment and sustainability education through researching learning pathways among key occupations that are responsible with rehabilitation practices in this case study; this will be addressing what Lotz-Sisitka and Ramsurup (2012a) refer to as exploring the possibility of identifying absences in the learning pathways.

1.5 Research aims and goals

This case study seeks, within the context of learning pathways:

- To understand the learning pathways associated with key occupations with responsibility for rehabilitation practices of: 1) borrow pits, 2)coal mining
- To explore how the learning pathways enable the development of competence for rehabilitation practices (what knowledge, skills and values are needed) in the selected occupations in the two cases
- To understand the learning system dynamics and factors that enables or constrains learning pathways for improving rehabilitation practices in two cases.
- To identify key access and articulation issues that influences the said learning pathways in the two cases.

The research design and research methodologies are determined by the above stated research goals.

1.6 Research questions

In line with the research goals and aims, the following are the research questions that guided the research process:

- What learning pathways are needed for rehabilitation practices in mining? A case studies of two practices.
- How is the specialist competence (combination of knowledge, skills, values and work experience) acquired?
- What education and training opportunities are specific occupational workers gaining access to; making use of?
- What support systems are in place (or not in place) to enable learning pathways for improved rehabilitation practices in the two cases? This will include investigating what education and training programmes are available, whether people are being sent on appropriate training, whether resources exist for training and/or whether

workplace mentorship or other system factors play a significant role in enabling or constraining the learning pathways.

- What access and articulation issues emerge in the learning pathways of the selected occupations?

1.7 Overview of the study

As mentioned above, this study focuses specifically on learning pathways in the mining industry, with specific reference to learning pathways with key occupations involved in two cases of rehabilitation practices.

Chapter 2 depicts key aspects in relation to the research through outlining the emergence (history) of learning pathways. A context discussion (contextual profiling) begins with the performance of mining industries in the Southern African context whereby I discuss issues of demand for training programmes and skills development at workplace level and also the connections between lifelong learning and learning pathways.

Chapter 3 explains the processes by which data was generated, analysed and managed. It discusses the type of methodology employed within two case studies being investigated, namely; semi-structured interviews, career stories, document analysis, field observations and visual photographs. Thereafter I discuss how I, as researcher dealt with the issue of participants in relation to ethics, trustworthiness and data validity.

Chapter 4 reveals the key occupations of learning pathway career stories based on the logic of my choices when selecting my participants. It also discusses and articulates each finding in relation to the rehabilitation practices, with emphasis on education and training, and how such processes shape lifelong learning in the workplace.

Chapter 5 identifies and discusses the major theoretical issues and contributions in the study with respect to the provisioning of learning pathways. This chapter will also explain the main conclusions and recommendations across the case studies with regard to learning pathways and rehabilitation practices in the mining industries.

CHAPTER 2

THEORETICAL AND CONCEPTUAL FRAMEWORK

2.1 Introduction

The potential for a successful Human Capital Development Strategy (HCDS) in the environmental sector lies primarily in its capacity to speak effectively to the needs and priorities of those in the sector and the many challenges they face in practice (HSRC, 2009). This chapter discusses key areas related to this study and also outlines the discourses by examining the structure of the sector. It proceeds to identify the factors that might lead to the development and/ or improving the rehabilitation practices in the mining industries concerned (case study 2). It also discusses forces that promote and inhibit growth of the National Skills Development Strategy, which focuses much of its attention on addressing skills that are in short supply (Maree, Lundall & Godfrey, 2008). Significant for this research programme are insights from Luhmann's work on systems theory. Lotz-Sisitka and Ramsurup (2012b) point out that, systems are made up of inter-related parts, and there is a relationship amongst the parts and the parts with the whole. In this study, it means that there is relationship amongst the Qualification Council for Trades and Occupations and the Council for Higher Education (the parts or subsystems) and the NQF system responsible for provision of education and training relevant to rehabilitation practices.

2.2 Learning pathways

As mentioned in Chapter 1, this research focuses on learning pathways to promote lifelong learning and sustainability at workplaces. Such learning pathways need to be relevant to sectors and their objectives (SAQA, 2003). Lotz-Sisitka and Ramsurup (2012b) found that at macro level the NQF lacks adequate structures to deal with new emerging fields of knowledge and practice such as environment and sustainability, particularly when related to public goods issues (such as environmental protection for current and future generation well-being); in such a context relevance, articulation and learning pathways become a problem. Hence there is need to investigate learning pathways that are related to new

environment and sustainability practices such as rehabilitation which involves learning new change oriented workplace practices (ibid).

The term *learning pathway* is interpreted as a journey of learning, but in a variety of ways. It is rarely perceived as being linear (Harris, Rainey & Summer, 2005). In some instances, the notion of learning pathways is recognised as implying a commitment to lifelong learning. Moreover, many do not feel that this term is the most apt description for their own learning history. Instead, they used such terms as 'stepping stones', 'zigzags' and 'crooked paths' (Lotz-Sisitka & Ramsurup 2012b). Reasons for this irregularity of path includes among others, lack of guidance, lack of fit between courses attempted, inexperience and lack of course prerequisites (Harris et al., 2005). Ramsurup (2012) defines learning pathways as the way we navigate and sequence our learning, skills development, education and training to attain competency towards an occupational context. Systems theory can help to interpret learning pathways as a range of complex system factors involved in navigating particular learning pathways which combine to be influential in a particular workplace (Von Bertalanffy, 1962), for example combinations of skills which one has to acquire for different work experiences, such as being able to successfully bring about mine rehabilitation.

Different people describe learning pathways based on their specialised perspective. Mukute (2011) in micro-analysis of learning and agency in agriculture workplaces said that the notion of learning trajectories or pathways can help one understand the evolution of common understanding in a group, that is, in collective or system learning processes. This study will focus on learning pathways in key occupations concerned with rehabilitation practices in the mining industries, and will take a broader view of learning pathways to that, suggested by Mukute (2011). It will work more with the definition of a learning pathway provided by Ramsurup (2012).

The Llywodraeth Government (2011) describes learning pathways as consisting of a blend of six key elements which, in combination, will ensure that, over time, all learners receive the appropriate balance of learning experiences that best meet their needs. The key elements also enable learners to receive the support and guidance they need to realise their potential. The six key elements which the Llywodraeth Government suggested are:

- individual Learning Pathways to meet the needs of each learner;

- wider choice and flexibility of programmes and ways of learning;

- a Learning Core which runs from early ages through to wherever young people are learning;

- Learning Coach support; (or learning mentoring)

- Access to personal support; and

- Impartial careers advice and guidance.

From this it is possible to see that learning pathways discourse encourages more young people to achieve their potential so they are increasingly better equipped for the world of work and to become better informed and more active citizens. The Llywodraeth Government believes that it will do this by contributing to an improvement in qualifications, supporting an improvement in the proportion of young students progressing to further learning in education and training, widening choice, promoting equality of opportunity and supporting the achievement of expanding opportunities for young people (ibid). This differs somewhat from the way I interpret learning pathways in this study, which investigates learning pathways from the workplaces and around key new practices (rehabilitation).

Provisioning of learning pathways occurs primarily in schools, colleges, technikons, and universities. These are the social system instruments that carry direct responsibility for managing teaching and learning process, including finding practical and educationally acceptable solutions for changes which are occurring results of changing pathways (Bengu, 1995).

When it comes to learning pathways at the workplace specifically, there is the potential to go in two different directions. There can be a focus on the articulation between education and work in order to recognise and provide credentials for all forms of learning or path, drawing on cognitive theories of learning pathways which tend to be individualistic and atomistic. There can also or instead be a focus on the workplace as a learning environment where learning pathways are a process embedded in production and organisational structures. In this sense learning pathways are about participation in certain aspects of practices, for example rehabilitation practices, sustainability practices etc. (Cullen et al., 2002). An ideal approach might be to combine the two directions through an ongoing

refinement and extension of theories concerning learning pathways, workplace learning, and education and training (Mitchell, Henry, & Young, 2001). While not necessarily seamless, the available sectoral moves and pathways or career support-pathing appear to be both functional and effective and are used by people as a substantial programme that improves qualifications and that can promote sustainable employment and in-work progression (Harris et al., 2006; DHET, 2011). The process may be enhanced by targeted, accessible and accurate information and by provision of career advice. My research interest seeks to give serious attention to these dimensions of learning pathways research, and will probe the sector's capacity to build on existing strengths and create new learning pathways opportunities for improving rehabilitation practices in the mining industry in the context of NQF structures and processes.

2.3 Skills development demands and training programme context

The notion of skills development and competence in South Africa especially in the professional categories, is one of the greatest challenges facing SAQA's attempt at developing skills, knowledge and understanding required from competent practitioners in South Africa (Kraak, 2004). This study seeks to add to understanding of skills development, by suggesting that skills development further interrogation can be facilitated by investigating learning pathways (HSRC, 2003).

Skills are understood to refer to both qualifications and experience, in the parlance of the Department of Labour and the Sectoral Education and Training Authorities (SETA). Skills are often referred to in the context of occupations in which qualified and experienced people, currently or anticipated in the future contribute to the economy or to society; an example would be an Environmental Manager (Foodbev SETA, 2005, p. 42). Daniels (2007) outlined that skills development in South Africa was facilitated by at least four important policy documents: the Skills Development Act (1998), the Skills Development Levies Act (1999), the National Skills Development Strategy (2001), and the Human Resources Development Strategy (2001). These have since been revised and updated and today one can find a National Skills Development Strategy III (DHET, 2011) and a new Human Resource Development Strategy (HSRC, 2009).

There is always a challenge in skills and competence development because of the dynamic nature of the labour market and the mining industry in particular. This challenge in the mining industry is exacerbated by the fact that the mining industry still employs a large number of people who are functionally illiterate. This places a challenge for skills development to continue to engage with the Higher Education and Training system and for policy makers to propose creative ways of addressing illiteracy in the workplace (Chamber of Mines, 2007). The Skills Development aim of the mining industry, the MQA who actively participates in and contributes to such bodies as the National Skills Authority (NSA), the South African Qualifications Authority (SAQA), the Quality Council for Trades and Occupations (QCTO), the National Board for Further Education and Training (NBFET), the Human Resources Development Council of South Africa (HRDC-SA) and Business Unity South Africa (BUSA) all aim to influence and contribute to (ibid):

- the education legislative framework
- the skills development legislative framework
- engagement with other social partners at NEDLAC
- strategic initiatives proposed at the HRDC-SA (Chamber of Mines, 2007).

Competence is a perception of ability in another person or in one's self (Sandberg, 2000). Competence has been described in terms of both task-specific skills and general social skills (ibid). Supported by Sternberg (2005), Sandberg (ibid) outlined that other research fields such as human resources, mineral industries etc. see competence in terms of general workplace skills. Sternberg (2005) describes competence in terms of problem solving ability, verbal ability and social competence and found that individuals often consider these factors in their assessment of competence. These same skills, among others, were also found to be the minimum skills required by employees in the workplace (O'Neil, 1999). Different workplace contexts acknowledge this understanding of competence (Csech, 2003) as Jeris and Johnson (2004) note, the distinction of competence in workplaces is often strongly influenced by providing access to education and training career opportunities that enable achievements reflecting some aspects of lifelong learning for workplace competence development. DYNA Training (2005) provides a review of competence, and identifies skills deemed by industries to be the scarcest among managers. These are: leadership

competence and professional competence. This was also identified as an issue for South Africa in the ESSP (DEA, 2010). Horwitz and Bowmaker- Falconer (2003) in the HSRC Review (2003) identified two key competence related challenges facing SA mining industries and other stakeholders: (1) building managerial competencies, and (2) harnessing managerial diversity. From this it is possible to see that learning pathways are needed that can help to develop such competences, and to expand and harness diversity.

SAQA (2003) regarded the Recognition of Prior Learning (RPL) (or the recognition of current competence) as a strategic goal of the NQF for which appropriate incentive and assessment procedures must be available. The departments (Education and Labour) agreed with the Study Team's proposals at the time that the place of RPL will be particularly important not only in the measurement of current competencies against standards but also in assisting learners to navigate the articulation column in order to progress in a learning pathway or across pathways (SAQA, 2002). However, the South African NQF is yet to establish substantive and accessible RPL procedures (ibid) see also http://www.saqa.org.za.

For several reasons, the extensive provision of short courses has proved to be a difficult matter for the NQF system, and SAQA has justifiably given the issue considerable attention (SAQA, 2000). In 2000-01 SAQA compiled an electronic record of short courses from information voluntarily supplied by providers, in order to understand the nature of short course provision as far as possible, bring it within the ambit of the NQF standards generation and quality assurance processes. A helpful discussion document on *Criteria and Guidelines for Short Courses and Skills Programmes* followed (ibid). The DEA (2010) study on skills development showed that short courses were one of the main mechanisms facilitating environmental learning pathways in South Africa, especially in and for workplace up-skilling to accommodate new environmental practices needed for sustainable development.

2.4 Workplace learning and lifelong learning

Workplace based learning was neglected in the apartheid era and very little concern was shown for the professional development or career path (learning pathways) options of workers, particularly black workers (Lotz-Sisitka & Olvitt, 2009). However, the urgent

necessity of the South African Qualifications Authority and its research interest in Work and Learning (under which this research programme falls) is showing that in all cases studied, education and training programmes (governed by various structures of the education and training system) are a significant factor that can potentially shape and enhance *change oriented* workplace learning; and that these education and training programmes themselves emerge from a complex set of inter-acting activity systems; with various tensions and contradictions emerging at the interface of these activity systems (Lotz-Sisitka & Ramsurup, 2012a). This has played a part in starting up some decisive new developments which, as mentioned, are centred on upgrading workplace learning; hence the direction seems to have a great appeal for the mining sector, environmental sector and among the agents in labour-market policy (Illeris, 2003).

Workplace learning has become an increasingly important issue during the last decade. It is recognized as an effective means of developing knowledge and skills in the existing workforce, thereby making a strong contribution to resource based industrial development (ILO, 2007), hence the Human Resource Development Strategy (RSA 2004) stresses that, improved knowledge and skills among workers is particularly relevant. This is important for the mining industry, as mining industries increasingly use new technologies and explore high performance work practices that are transforming the ways in which work is organized, based on workplace learning and training (Kraak, 2009).

It is generally thought that South Africa has serious skills shortages and that environmental practitioner and rehabilitation training are particularly important categories of scarce skills (Maree et. al., 2008; HSRC, 2009) as mentioned above, workplaces are often associated with competences and they provide an interesting perspective on learning that takes place (Mukute, 2010). In support of this, requirements for appointing competent persons on the mines, the Department of Minerals Resources develops, implements and controls the issuing of certificates of competency for specific mining related qualifications such as certificates of competence for engineers, mine managers, Mine Overseers and Surveyors (MQA, 2009a). The mining industry also has a shortage of skills in the area of mine environmental control practices and biotechnology (MQA, 2009b). A further recent development is the establishment of the Quality Council for Trades and Occupation (QTCO)

that will assure the quality of all occupationally based learning in South Africa, inclusive of components for the Governments Certificates of Competency (ibid).

South African society has adopted a development path that is oriented towards sustainable development, included within this are recent developments and implementation of the NQF (established by the NQF Act of 2008, RSA 2008). This involves various initiatives to design and develop qualifications that respond to the environmental rights and sustainable development aspects of working life (Lotz-Sisitka & Olvitt, 2009; Lotz-Sisitka, 2010). At the same time there is still is a great deal of confusion and uncertainty concerning more general qualifications and personal competences which are regarded as increasingly central and vital (Illeris, 2003). This applies to environmentally oriented qualifications and competences in South Africa too, as reported in the ESSP (DEA, 2010).

Wider analysis has shown that the whole system of training provision for workplace learning and sustainability practices is poorly constituted, and is reactive, rather than pro-active (DEA, 2010). The South African landscape of education and training and skills development is standardised and aligned through the provisions of the National Qualifications Framework (DoL and DoE, 2007). The NQF provides for an integrated qualification framework to ensure progression and portability of all qualifications (whether attained at school, university, college, or in the workplace) (HSRC, 2009). NQF levels now extend from 1 to 10 as outlined in the table below. The Human Capacity Development Strategy of the mining and/or environmental sector, NQF 5-10 level is situated on the Higher Education and Training Band.

Table 2.1: National Qualification Framework

Education Band	NQF	Skill band	Qualification type
Higher Education & Training	10	High skills	Doctorate
	9		Masters degree
	8		Postgraduate diploma/honours
	7		Bachelors degree/advanced diploma
	6	Intermediate skills	Diploma/advanced certificate
	5		Higher certificate or advanced national certificate (vocational)
Further Education & Training	4		National Senior Certificate or College National Certificate 3 (Vocational)
	3		College National Certificate 3 (Vocational) or Grade 11
	2		College National certificate 2 (Vocational) or Grade 10
General Education &Training	1	Entry level skills	Grade1-9

Source: Kraak, 2008: 5; DOL, 2008a, Cited from Human Scientific Research, 2009.

New workplace practices are addressing some of the problems associated with the impacts of modernist practices (Mukute, 2010). In July 2009, a qualification was registered with the South African Qualifications Authority (SAQA) for site preparation and rehabilitation in the mining industry: the National Certificate: Environmental Practitioner at NQF Level 3. This qualification began to provide for a learning pathway for workers in the borrow pits and coal mining sectors (SAQA, 2009). This qualification can also serve as a basis for further

learning, and can equip learners with knowledge, skills and values to participate meaningfully in society and contribute towards sustainable development.

Workplace learning is a key part of this, driven by the impact of changes in exploitation of natural resources, skills demand, technologies, and people's relationship and roles within various institutions, organizations and communities (Vaughan, 2008). This includes support functions or practices such as planning, research, governance, environmental education and training, management and sustainability practices which are essential to all sub-fields of the NQF and are also relevant to environmental skills planning (DEA, 2010). For these reasons workplace learning and competence development are more interesting focus points for late modernity, globalisation and the knowledge society (Illeris, 2003) hence, workplace learning becomes part of the SAQA's commitment to development of human competence across sub-fields and subsystems of the NQF.

In the context of this study I use workplace learning to reflect on challenges and articulation issues that arise in learning pathways relevant to rehabilitation practices in the mining industry, as this sheds light on how workers learn skills on the job. A focus on workplace learning helps to explore whether required approved training programmes are related to workers' specific tasks and/or if others are needed. As environmental concerns and awareness have become more important in workplaces, there is need for learning to take place. This involves either those who are experienced or who are newer in the mining industry. Both experienced and new employees can be trained environmentally depending on the environmental practices relevant to their occupations.

Edwards, Raggatt, Harrison, McCollum and Calder (1998) concisely draw out key points relating to lifelong learning as it identifies greater emphasis on developing skills, competencies and capabilities. They go on to say that lifelong learning can be understood in a number of ways: it can be referred to as post-school education, concerned with adults who have left their formal education and training and who return to learning at later dates. Lifelong learning as driven by the imperatives of late capitalism has become a key concept in the thinking about education and training in the workplace environment (Walters, 1999). The European Commission specifies that lifelong learning is all learning activity undertaken throughout life, with the main aim of improving knowledge, skills and competencies within a

personal, civic, and social and/or employment related perspective (Europa, 2003). With the recent transformation of education and training in South Africa, lifelong learning is organised in terms of the NQF, which seeks to increase learning opportunities and remove barriers to learning for all (Christie, 1996).

Moreover, leaning pathways available in the system of the Mining Qualification Authority's education and training must therefore be cross sectoral (DoE & DoL, 2003) as not all skills can be provided for by the sector subsystem. Lifelong learning, however, seems to be a panacea unless it can be practically realised and provided for (Walters, 1999). In relation to rehabilitation practices, this should mean that key occupations each have individual learning pathways, suitable to their needs and interests and that rehabilitation practice learning pathways may be diverse, and may also need to be constituted in a cross sectoral way for example, some aspect of rehabilitation practice training maybe offered by the conservation sector, rather than the mining sector (ESAE, n.d; HSRC, 2009).

The perceived reason why learning should be encouraged throughout life is varied (Cropley & Knapper, 1983) but importantly, is seen also as providing second chances to update basic skills and offer learning opportunities at a more advanced level (ESAE, n.d). Candy, Grebert and O'Leary (1994) argue that since learning is never finished, it follows that the mandate of workplace learning must foster and support lifelong learning in the mining industry with respect to rehabilitation practices. Broadly speaking from the context of Environmental Education and Training this could provide learning opportunities (career path), including articulation with learning and workplace contexts and develop the skills and attributes of lifelong occupations (Walters, 1999) for example, an environmental manager may become a rehabilitation specialist.

2.5 Rehabilitation practices in S.A

Rehabilitation, from the mining industry perspective, means putting the land impacted by mining activity back to a sustainable usable condition (Swart & Tanner, 2007). Basically, rehabilitation is to bring back the degraded land to a normal stage by special treatments, mitigation measures that address and rectify disturbed environmental conditions created

through mining activities (Panigrahi & Murthy, 2008). It is vital that rehabilitation of land takes place once mining has ceased (World Coal Institute, 2005). However, the term rehabilitation in a mining context includes the development of management strategies to restore and maintain physical, chemical and biological ecosystem processes in the degraded environments and on these disturbed areas. Rehabilitation practices have been conducted for centuries with the ultimate success thereof being largely dependent upon the prevailing environmental conditions, the landscaping of the site areas, and resources available to the specialised key occupation undertaking rehabilitation and policy requirements (Risser, 1992).

Rehabilitation practice is, however, not only about rehabilitating the environment that was adversely impacted by mining; it is also about management of developmental activities within the limits of the assimilative capacity of the environment (Rogers, Jalal & Boyd, 2005). The maintenance of ecological integrity should be a fundamental feature of all rehabilitation practices as rehabilitation is the basis for evolution and adaptation to changing environments, making it essential for survival of life (IAIAc, 2003, p. 2). This practice plays a significant role in sustaining the resilience of ecosystems, which tend to be more resilient when there are many species performing essential functions (e.g. photosynthesis, decomposition). Each responds in different ways to outside disturbances so that species can replace or compensate for one another in times of severe disturbance (Gunderson & Holling, 2002).

Rehabilitation practices of the mining industry need to become increasingly sophisticated as environmental impacts become better understood and community and government expectations of long-term landscape sustainability become increasingly stringent (Hancock, 2004). Understanding clear learning pathways together with best rehabilitation practices of the ecosystem affected by mining, the primarily conditioned key to successful rehabilitation will be establishment with maintenance of vegetation as well as erosion (Toy & Hadley, 1987)

South African legislation governing mine closure and rehabilitation practices, particularly the Mineral and Petroleum Resources Development Act (28 of 2002, RSA 2002), requires

rigorous mitigation of both biophysical and socio-economic impacts (Limpitlaw et al., 2005). Before this Act, closure was governed by the Minerals Act (Act 50 of 1991). The Minerals Act (RSA 1991) provided statutory requirements enforcing environmental protection, the management of environmental impacts and the rehabilitation of the affected environments of prospecting and mining in South Africa.   Many mining companies "*used irresponsible mining methods with no regard towards protecting the environment and had often shirked their responsibility towards environmental rehabilitation by leaving an area unrehabilitated prior to them being liquidated or leaving the country*" (Swart, 2003, p. 489).

2.5.1 Description of the sector (mining industry) in SA

Major environmental problems associated with mining in South Africa appear to have received little attention until recent years (Lumby, 2005) and the mining industry has also been a major source of polluting both surface and ground-water resources which has led to acid mine drainage in Mpumalanga and Gauteng provinces, through the generation of industrial waste (CSIR, 1992).

Case study of coal mining

South Africa is a country with a long tradition in mining and therefore also in sustainability and scientific education (Schluter & Trauth, 2008). Following the discovery of immense resources in South Africa, the mining industry played a central role in the country's economic, political, and social environment (Viljoen & Reimold, 1999). Minerals in South Africa are diversified, plentiful and profitable (ibid). Coal mining in South Africa is a mature industry and there are a large number of collieries in the country's major coal fields (Limpitlaw et al., 2005), but the South Africa coal mining industry remains unbalanced with rising coal demand on one hand and constrained supply sources on the other (Frost & Sullivan Mining Industry Analyst, 2009).

The history of coal mining in South Africa is closely linked with the economic development of the country (McCarthy & Pretorius, 2009), and currently South Africa it reliant on coal for the generation of almost all the electricity used in this country (de Korte, 2010). South Africa is also the fourth biggest coal exporter in the world and the fifth producer in the world. It remains a global centre for the industry containing large reserves (Schmidt, 2010). Despite

such benefits, the activities of the mining sector have resulted in serious environmental consequences, notably in respect of poor environmental positioning, in the case of the Witbank Coal fields, and acid mine drainage (AMD) (IMC, 2010). A number of environmental problems have emerged as a result of mining industries (McCarthy & Pretorius, 2009); these can be best exemplified by the Witbank coal fields as it is part of my case study on rehabilitation practices where a long history of mining exists (see Chapter 4).

Lotz-Sisitka (2012) in proposing that learning pathways are needed in the mining industries to improve rehabilitation practices outlined that environment is the basis of multiple forms of life and provides resources for many ecological and economic activities. Mining industries and associated unsustainable patterns of development which exploit not only resources and resource flows, but also labour and people, are increasingly affecting a wide variety of social practices, including workplace practices. In response various sustainable development practices are emerging in workplaces (not only in South Africa, but globally), which have relevance in a range of different education and training sectors (all three of the quality councils mentioned earlier). Her argument for focussing on rehabilitation practice learning pathways is based on an earlier study by the HSRC (2009) which identified rehabilitation capacity as a critical skill needed for biodiversity management in South Africa. This study identified this as a core practice in the mining industry.

Coal mining has been taking place in the Witbank area for more than a century (McCarthy & Pretorius, 2009) and the area is replete with examples of negative aspects of mining listed above, as well as rehabilitation practices. As mentioned above, mining is, and has been for many years, a vital component of the development of South Africa. At the same time, mining has resulted in major impacts, both environmental and social, that have not been fully recognised or dealt with (Swart & Tanner, 2007).

The environmental management regulations contains guidelines, operating procedures and rehabilitation control requirements which will be binding on the holder of the mining permit/ prospecting permission/ reconnaissance permission after approval of the Environmental Management Plan (Department of Minerals and Energy, 2008). Mines have to comply with South African Constitutional and common law by conducting their operation and closure activities with due diligence and care for the rights of others. There are current legislative

frameworks governing coal mining, for example National Environmental Management Act, 1998 (Act No. 107 of 1998), Minerals and Petroleum Resources Development Act, 2002, Mine Health and Safety Act, 1996 (Act No. 29 of 1996) and the National Water Act, 1998 (Act No. 36 of 1998) (Swart, 2003).

In recognising the role of education and training in this context, Lotz-Sisitka (2008) proposed that in the first phase of the programme (Rhodes University/ SAQA Research Programme) should include the development of research frameworks and instruments for investigating how *change-oriented workplace learning* takes place in the context of *sustainable development practices.* Findings from this phase (2008-2010) highlight how different types of learning processes influence change in practice; ways of supporting learning systems in workplaces; and mechanisms for mobilising learning opportunities in response to challenges (including skills development challenges) in workplaces and pointed to the need for learning pathways research. No learning pathways research for environmental practices especially rehabilitation practices in South African coal mining could be found, indicating this to be a gap in knowledge on how to address such issues in the mining industry, hence this research (Lotz-Sisitka, 2010).

Case study of borrow pits

Several types of road building materials are required and/or utilised for construction purposes, possible sources of such materials are identified as borrow pits (SANRAL, 2008) by geotechnical studies. Borrow pits are considered mining activities (BMMR, 2009). The term refers to an open pit where material (soil, sand or gravel) is removed for use in another location (GDACE, 2008); this can be for the construction of dams, roads, embankment buildings and other structures, such as manufacturing of bricks and concrete.

Borrow pits as well as other types of mines are somewhat unique (BMMR, 2009) in that they are generally shallower and located in close proximity to the area where the material will be used (GDACE, 2008). Historically, rehabilitation was typically limited to the removal of equipment following the cessation of activities; this practice was not only lax, but was

unacceptable from a community safety and environmental sustainability perspective (ASPASA, 2009).

However, before the establishment and granting of the mining rights/or permits for this activity, the South African Government is now issuing new guideline workplace practices that are addressing some of the problems associated with this practice such as those promoted for in the NEMA Act of 2008. These include practices such as environmental impact assessment, energy conservation, water resource management, environmental education and biodiversity conservation (Lotz-Sisitka, Motsa, Mukute & Olvitt, 2008). In terms of the Mineral and Petroleum Resources Development Act of 2002 (RSA 2002), the holder of the mining right/permit and the management remain liable for any pollution or ecological degradation, until a closure certificate has been issued for the site.

2.6 Learning pathways in the mining industries for rehabilitation practices

The environment is a rapidly emerging sector, and consequently, there is no dedicated environmental Sectoral Education and Training Authority (SETA) in South Africa and environment needs to be integrated in all SETA's (DEA, 2010). This has proven to be one of the most intractable challenges in this sector as no mechanism exists for dealing with such cross cutting issues on the NQF (DEA, 2010). Lack of career path is consistently cited as a fundamental constraint in the mining sector related to rehabilitation practices in the mining industries (HRSC, 2009). The DEA (2010) identified the environmental sector as a complex, cross-cutting and emerging sector, and until 2010 no coordinated skills planning had taken place at sectoral level in South Africa.

Where mining takes place, the land is usually cleared of all vegetation, the landscape drastically altered and the ecosystem totally disrupted. Panigrahi and Murthy (2008) argued that rehabilitation brings back the degraded land to a normal stage through special treatment. If the mining industry is to contribute effectively to future sustainable development, it must develop and consistently apply sound rehabilitation practices (Gardner, 2001). Lawrence (2001) sited that for effective rehabilitation, a diversity of competences and skills related to agriculture, forestry, nature conservation or urban and industrial land use need to be merged to have a consistent and transient practice. This is supported by Moffat (2001) who emphasised that rehabilitation (also referred to as

reclamation) should be a process of converting mined land to its future valuable use and this can be planned and implemented through relevant pathways.

In South Africa, a guideline for the rehabilitation of land disturbed by surface coal mining was first published by the Chamber of Mines in 1981. This provided excellent guidance for coal strip mine rehabilitation, but both legal requirements and rehabilitation objectives and procedures have changed considerably over the last twenty-five years. Internationally, a number of rehabilitation guidelines have been produced. In particular, the Australian mines rehabilitation and mine closure and completion guidelines are of relevance. These "new" South African guidelines are intended both to update the previous coal-based strip-mining guidelines and to expand them for use with other mining methods. They are a compilation of current "best practice", both South African and international, and are aimed at providing the basis for the "how" to go about achieving a satisfactory, sustainable, rehabilitation end-product following mining (COALTECH, 2007).

For example in Australia, rehabilitation of mines should establish land use values equal to or better than those existing before mining (Gardner, 2001). The Australian Minerals Industry Framework for Sustainable Development established an "Enduring Value" specifically aimed at supporting mining companies to go beyond compliance to rehabilitate mining areas. They seek continual improvement of the environmental performance from the mining industry in this format: Rehabilitate land disturbed or occupied by operations in accordance with appropriate post-mining land uses; consult relevant stakeholders and develop a closure plan that clearly defines the post-closure land use; where appropriate, rehabilitate progressively over the life of the operation; monitor success criteria agreed with relevant stakeholders, and report performances. Undertake and support research into land and water rehabilitation practices. Use appropriate technologies to reduce negative environmental impacts and improve site rehabilitation techniques. Manage and, where appropriate, rehabilitate historical disturbances to an appropriate standard.

In the South African context, what has been done to rehabilitate the mining areas is aligned with the national and regional Integrated Development Plan (IDPs), which may or may not match local community wishes. However, rehabilitation is aligned with Environmental

Management Plan and Closure Plan Objectives and commitments, and must provide for a sustainable post-mining land use. Consensus on these commitments has to be reached through a Public Participation Process before permission to mine is granted (Chamber of Mines, 2007).

As already mentioned above, the idea of a learning or career pathway may convey the notion of a linear progression through the education or job hierarchy respectively. Quite rightly, from the outset the design of the South African NQF has been based on a non-linear progression model that reflects the varied nature of individual learning and career choices, especially in the current era of rapid knowledge growth and occupational change (DoE & DoL, 2003). The concepts of articulation and mobility have been built into the NQF progression model because learners and workers need to be able to exercise their options to move vertically, horizontally or diagonally between learning or career pathways as the case may be in the mining industry when dealing with rehabilitation practices, with due credit for learning achieved. The idea or notion of a pathway as embodying an organised sequence of connections or switching points is more appropriate to the rehabilitation practices circumstances (ibid), as these are new practices which are generally integrated into existing occupations.

Concerns about rehabilitation in the mining industries have become widespread over the past four decades (Rolfe, 2000). If the mining industry is to contribute effectively to future sustainable development, it must consistently develop education and training programmes on rehabilitation practices that should establish land use values equal to or better than those existing before mining (Gardner, 2001). Panigrahi and Murthy (2008) stressed that, mining does not mean permanent loss of land but it holds potential for altered and improved use including restoring land for agriculture, forestry and irrigation, provided planned measures are taken from the pre-mining till the post mining stage, therefore simultaneous reclamation and rehabilitation practices of degraded area is vital. This indicates that "rehabilitation training" needs to be integrated into the full cycle of mining qualities, and is therefore likely to involve a number of different professionals and workers at different occupational levels with diverse responsibilities.

The mining industry needs a steady supply of skilled professionals entering the workforce and they must be trained to be recognised as more complex and technical (MMSD, 2002). For a competitive mining industry, South Africa needs an education and training system which provides a high quality secondary and tertiary education to meet the industry's operational and strategic needs in a cost-effective manner. The learning system should provide employees with flexible skills and attitudes to contribute to the profitability and safety of the enterprise (Department of Minerals and Energy, 1998). The Department of Minerals and Energy will continue to promote representivity and redress past imbalances in selection of staff and in its support for internal education and training (ibid).

The 2011 Sector Skills Plan (SSP) for the Mining and Minerals Sector (MMS) states that it strongly supports skills development through higher education and involves a range of training and development initiatives that focus on developing the skills of the current workforce. These initiatives both supplement and build on the training that supplies new skills in the sector, and are a critical source of supply, particularly for the mining industry.

The 2011 scarce skills list of the MQA notes that not only are environmental managers in short supply, but also training facilitators and environmental related skills issues. A workforce environmental awareness training program is aimed at those educators, trainers, skills developers and managers who feel a burning desire to enhance their career and other learning opportunities by embracing and achieving an enduring improving environmental culture amongst all staff in their education and training environments (Bisschoff, Govender & Oosthuizen, 2004) is necessary. Implementation of education and training related to rehabilitation practices is not new, it has been there for the past decades (Behr, 1984).South Africa's mining industry is faced with skills gaps, an ageing but highly skilled workforce, and issues to do with quality of education and training. The need for competent practitioners increases as people's needs to acquire the skills necessary for employment grow (Department of Labour, 2005).

Policies such as Broad-Based Economic Empowerment, Industrial and Sectoral Charters, National Skills Development Strategy and skills development legislation offer opportunities for improving skills and up-skilling. However, the challenge is still daunting for rehabilitation

practitioners and the task of appropriate skills development awaits all South African mining industries when it comes to improving their Rehabilitation (Telela, 2004). This is because rehabilitation in coal mining is not easy; it is a complex process requiring a complex set of skills. A paper by Limpitlaw et al., explains this complexity, which I summarise here, highlighting the need for skills:

Table 2.2: Rehabilitation in coal mining

Limpitlaw et al., (2005) key points about rehabilitation practices	Skill demand and analysis
Landscaping	Architect or gardener (ensure that the land is stable and will not erode and provide an adequate substrate for revegetation).
Soil removal, respreading and stockpiling	Soil Scientist (indicate the location and the depth of soil stripping, and also give respreading techniques with a view of minimising soil compaction that can inhibit later revegetation; in cases where stripped soil cannot be spread, it should be stockpiled, and should be located away from drainage line).
Seedbed preparation	Biotechnologist and Horticulture (create genetically modified seeds and indicate seedbed treatment, and give the species used in revegetation).
Water	Hydrologist (advise on a range of techniques that can be applied to control runoff and erosion on mine sites, and also to control the earth's water, especially when the water table rises)
Acid mine drainage	Geochemistry (collecting and treating of runoff from stockpiles, mine water and seepage from the tailing dams, and monitoring.

Table 2.3 Rehabilitation in borrow pits

Beukes (2008) study key points about rehabilitation practices	Skill demand and analysis
Ecosystem restoration	Ecology (protects plants and living creatures from each other and their environment.
Legislation	Compliance with the provisions of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002).
Awareness	Environmental Education (to deepen the understanding of educational responses to contemporary risk and vulnerability in the borrow pits and enable the development of competence in relation to specific rehabilitation practices).

SAQA draft explains that the learning pathways available in the system of public education and training must always offer a broadly based range of knowledge and vocational preparation.

As can be seen from the two tables above skills for rehabilitation are complex and require various people in various occupations to engage with them. This study will investigate how and if learning pathways exist for this in the two case study sites.

2.7 Conclusion

Learning pathways are critical to the achievement of efficient, open, integrated and relevant education and training sectors that can meet the challenge of rapidly changing needs and priorities for knowledge and skills development, including continuous skilling and lifelong learning (University of Barrat, 2003). Many new qualifications and education and training programmes are being developed within this broader globalisation framework in the southern African context (Lotz-Sisitka, 2004) after promulgation of the NQF. Such pathways may include access to qualifications, or other system arrangements (Lotz-Sisitka & Ramsurup, 2012).

CHAPTER 3

METHODOLOGY AND RESEARCH TECHNIQUES

3.1 Introduction

The way in which research is conducted may be conceived of in terms of the research philosophy subscribed to, the research strategy employed and research instruments utilised (and perhaps developed) in the pursuit of research goals. The philosophy and approach are often referred to as the research methodology (Brynard & Hanekom, 2006).

In working with congruous and/or appropriate theoretical framings with reference to research questions and goals, given the scope, focus and context of this research, I drew on theories that will help to understand and explain articulation issues in the workplace and what challenges are facing learning pathways in key occupations.

I start by elaborating the influence of learning pathways for improving rehabilitation practices on this study in relation to the development of this study design (section 3.2) and then proceed to describe the use and importance of the case study design for this research (section 3.3.1). I then outline the data generation methods from a theoretical perspective (section 3.3.2). I also share data management strategy which encompasses data organisation, backups, preservation, ensuring security of confidential data and sharing with the participants (section 3.4). I also discuss how I organized and analysed the data so that useful information could be extracted from it (section 3.5). Finally, given the importance of ethics in research, I report on how I dealt with issues of honesty, objectivity, integrity, carefulness, openness, confidentiality and respect for intellectual property (trustworthiness) in this study (section 3.6), thus addressing issues of 'research quality' (Litman, 2012).

This research is conducted using a case study design, which examines a phenomenon in its natural setting, employing multiple methods of data collection to gather information from one or a few entities (people, groups or organizations) (Benbasat, Goldstein & Mead, 1987, p. 369). As is the norm with case study research, while certain boundaries can be

established beforehand, the exact boundaries of the phenomenon are not clearly evident at the outset of the research and no experimental control or manipulation is used. When deciding whether to use the case study approach or not, there are a number of factors to consider. The case study approach, particularly how it relates to the research focus, is discussed in detail next.

3.2. Case study

As indicated in the previous two chapters, the aim of the study is to understand and probe learning pathways relevant to rehabilitation practices in the two mining contexts. Cooper and Emory (1995, p. 21) define research as a systematic inquiry aimed at providing information to solve problems, and it is the problem of inadequate knowledge of learning pathways relating to these practices that I examine in this study.

In order to avoid a new fragmentation of educational objectives and to integrate these concerns of coal mining and borrow pits with one another (Sauve, 1999) in the context of rehabilitation practice learning pathways, I draw on a system-based comprehensive, framework for environmental education, even though there have been others which have been proposed. The study design seeks to provide in-depth information on learning pathways in both cases. O'Donoghue, et al (2008) explains that case study research provides reliable data with varying amounts of detail and formality about a particular issue in a particular context. As shown in Table 2.2 and Table 2.3 in the previous chapter rehabilitation practices affecting different occupations are complex and require a range of skills and competences in different phases of the mining process. Thus I need in-depth understanding of these contexts.

The research design for this study uses interpretive descriptive case study using qualitative methods. Semi-structured interviews were held with four key occupations in two sites in order to appraise and assess the skills and competence required for key occupations on both sites and learning pathways to attain these. In addition, semi-structured interviews were also held with selected employees in these occupations to determine their level of satisfaction with their career journeys (learning pathways).

In this study various steps were adopted in order to understand the research questions along with the logic behind them. I found this necessary since Lotz-Sisitka and Ramsurup (2012) show that researching learning pathways is notoriously difficult and how such research lacks methodological refinement as it is often difficult to settle on a unit of analysis. In this research I use *"career stories"* since they are inherently dynamic (Lotz-Sisitka & Ramsurup, 2012) and allow for developing an understanding of learning pathways from contexts of practice.

The study explores the subjective perception of key occupations (workers) at the workplace that have a bearing on their decision making in ensuring a *change in workplace learning and lifelong learning* to accommodate knowledge of rehabilitation practices. The main focus of my research methodology is centred on uncovering and understanding career stories of rehabilitation practices in key occupations in two different case study sites. When deciding whether to use the case study approach or not, there are a number of factors to consider. If there is a need to focus on contemporary events or phenomena in a natural setting the case study is advantageous (Benbasat et al., 1987, p. 369).

The research orientation at an epistemological level, identified as appropriate for these learning pathways research is interpretivist (also known as anti-positivist) (Galliers, 1991). As indicated and reflected on in the first two chapters of the study, my passion for this study was to probe what education and training opportunities are being offered for the key occupations and how are they gaining access related to these rehabilitation practices. According to Willis (2005) and Myers (2009) interpretive researchers attempt to derive their constructs from the field through in-depth examination of the phenomenon of interest. Epistemological understandings are shaped through language, consciousness and shared meanings. In these two cases I research the meaning which the key occupations expressed in the learning pathways through career stories which draw on education and training histories for improving rehabilitation practices. The University of Barrat (2003) reports that:

> Learning pathways are formally approved links to enable students to enter and move between courses and programmes in different sectors or the same sector. Pathways may link courses and programmes in the same or different areas of study.

As indicated above, and as explained in Chapters 1 and 2, I selected two cases of rehabilitation practices in the mining industry to investigate learning pathways and their related sustainability practices in depth. Using a case study design method I was able to focus on such practices in key occupations and associated education, training and learning pathways experiences of the respondents.

The study was conducted in two case study sites in Limpopo and Mpumalanga Provinces in South Africa. Borrow pits in Limpopo Province (case 1) are inherently a destructive process and there are a number of post-mining environmental impacts that remain after mining or/excavation has ceased. Such impacts may include among others, erosion, siltation, formulation of water bodies/ponds (*these ponds may create breeding grounds for mosquitoes posing a risk of malaria and other related diseases*), permanent visual intrusion etc. Historically rehabilitation of Borrow pits mining sites was limited to removal of infrastructure following cessation of activities (Cooke & Limpitlaw, 2003). This practice was not enough as from a community perspective; it posed a safety risk to people and animals and from an environmental perspective sustainability was compromised. Although the land cannot be returned to its former state, every effort should be made to address potential residual impacts during closure.

Mpumalanga Province is rich in coal reserves and home to SA's major coal fired power stations. EMalahleni (Witbank coal-fields), the biggest coal producer in Africa was the site where this study was conducted. Coal mining particularly surface mining, requires large areas of land to be temporarily disturbed. This raises a number of environmental challenges, including soil erosion, dust, noise and water pollution, and impacts on local biodiversity. Steps are taken in modern mining operations to minimise impacts on all aspects of the environment. It is vital that rehabilitation of land takes place once mining operations have stopped. In best practice a detailed rehabilitation or reclamation plan is designed and approved for each coal mine, covering the period from the start of operations until well after mining has finished. Demand for rehabilitation skills in South Africa's mining industry has increased its appetite for rehabilitation services to ensure compliance with environmental legislation. Key occupations were sampled from both sites focussing on rehabilitation practices, and education and training. On the logic of selecting key

occupations for this study on learning pathways, the research often seeks to penetrate deeper to understand learning pathways associated with key occupations with responsibility for rehabilitation practices and develop career stories to understand the context on learning pathways. This required me to be immersed when it comes to sampling (selecting) of respondents in the research field. I established four occupations which would address the research problems/questions in-depth. Therefore two occupations from each site (case) were sampled.

The nature of the environmental problems and risks, and new policies are 'real causal mechanisms' influencing the emergence and need for learning pathways to implement and improve these practices, and as such in these research I also recognise some aspects of critical realist ontology (Bhaskar, 1997). The critical realist ontology helps in taking in to account how environmental issues and risks influence the empirical experiences that I investigate using interpretation. Its main interest is, however, in understanding the experiences and systems factors that influence the learning pathways, hence the primary focus on interpretation.

Interpretivists contend that it is through the subjective interpretation of and intervention in reality that significant aspects of reality can be fully understood (ibid.). The study of phenomena in the natural environment as system is a key to the interpretivist approach that are underpinned by critical realist ontology, together with the acknowledgement that different disciplines cannot avoid affecting those phenomena they study. Drawing from system theory (Von Bertalanffy, 1962) it is also possible that there are many different interacting aspects of reality or many different ways in which reality comes to be structured or practiced i.e. from this I came to understand that I should interpret dynamics and aspects of the learning pathways not only from what people say, but also from an understanding of interacting system elements. Thus I found that I could learn from interviews, documents and the narratives in the key occupations of the respondents' career stories.

3.3 Data collection techniques

As I have indicated above, this research design takes a form of interpretive case study approach under-laboured by critical realist ontology. This research design helped to provide guidance for choosing appropriate methods for the generation of data. Since most of the data needed was verbal and rich in a language sense (i.e. I had to understand 'career stories' relevant to rehabilitation practices), the research was qualitative in nature. Bassey (1999) recommends multi-method approaches in case study research. Evidence of case studies may come from the following sources; and in this study include:

- Document analysis
- Field work observation
- Semi-structured interviews
- Informal conversation
- Visual photographs

I discuss how each of these was used in a more explicit and detailed way below:

3.3.1 Document analysis

Except for studies of preliterate societies, document analysis or information is likely to be relevant to every case study topic as it provides a rich source of contextual and historical data (Patton, 2002). This type of information can take many forms and should be the object of explicit data collection plans. For instance, this research has considered the following variety of documents:

- Environmental Sector Skills Plan for South Africa (DEA, 2010)
- Relevant training materials focussing on training for rehabilitation practices,
- Written reports of events; especially research reports or management reports focussing on the improvement of rehabilitation practices in the two sites; I also examined environmental management plans for the specific mining sites, particularly to identify what rehabilitation practices have been recommended, and also which occupational categories are involved in the practices,
- Administrative documents: proposals; progress reports; workplace skills planning; training plans and other internal records,

- Newspaper clippings and other items appearing in the mass media or in community newsletters on the rehabilitation practices.

- Human Sciences Research Council (2009) Research report produced for the Lewis Foundation and the SA National Biodiversity Institute 'SANBI'

- Legislation and regulations guiding the two practices according to the respective learning pathways.

These and other types of documents were useful even though they may not always be accurate and may show signs of bias. Documents played an explicit role in capturing information about the rehabilitation practices in the cases; therefore a systematic search for relevant documents was vital in the data collection plan of this study. For example, during field visits, I allotted time for using the local library and other reference centres, and I asked for relevant documentation pertaining to the rehabilitation practices, and any associated training programmes.

Outlined below in Table 3.1 is a complete list of documents I reviewed in the study. I indexed the documents to ensure that I did not lose any valuable information, and also so I could also have easy access to my data, and so that I could provide a "data trail" showing where my interpretations were coming from.

Table 3.1 List of policy documents analysed in this study, with a brief description of the data obtained from the different documents

Name of the document	What the document provided	Index code
Skills development Act of 1998	Importance of skills in workplace environment	D1
Mid-term report by the deputy president Kgalema Motlanthe	Low skills development in South Africa can be attributed to weak education	D2
South African Qualification Authority Act No.58 of 1995	Development and implementation of the NQF	D3
National Qualifications Act No.67 of 2008	Open up learning and career pathways for all South Africans	D4
National Environmental	Skills demand and supply in the	D5

Management Act No.102 of 1998	environmental sector and regulations governing environmental practices.	

Table 3.2 Lists of workplace documents analysed in this study, with a brief description of the data obtained from the different documents.

Name of the document	What the document provided	Index code
Environmental Sector Skills Plan (DEA, 2010)	Skills development planning	D6
Human Sciences Research Council Research Report (2009)	Dynamics of professional and managerial learning pathways in the sector	D7
Department of Higher Education and Training (Based on International Labour Organisation)	OFO codes and/or details	D8
Organising Framework for Occupation	Articulates occupations descriptors and tasks based on the knowledge, skills and workplace experience needed to deliver services linked to that occupation	D9
Training manual (APCOR)	Employer to provide education and training	D10
Mining Qualification Authority (Education, Training and Quality Assurance 2003)	Promotion of the NQF in the mining industry	D11
Sector Skills Plan for the mining and mineral sector (2011-2016)	Skills improvement of the workforce	D12

Using all these documents, I started with document analysis for policy documents (D1-D5, see the Appendix 1) and then document analysis for workplace documents (D6-D12).

These documents provided insight into what the sector "says" about learning pathways for rehabilitation practices. I thoroughly read, reviewed and analysed each of these documents,

and extracted all the information relevant to leaning pathways, education and training, skills development and competence for rehabilitation practices in the sector. I structured this into analytical statements (see section 5.3.1) summarizing what the document said about learning pathways for improving rehabilitation practices in the mining industry and also the articulation issues of the key occupations used for analysis in the study.

3.3.2 Semi-structured interviews

One of the most important sources of case study information is the semi-structured interview and informal conversation. In this study I use semi-structured interviews (Yin, 2003). In each case I interviewed respondents from key occupations who have responsibilities for implementing aspects of rehabilitation practices so that I could understand the learning pathways necessary for improving these practices. I established their occupation, and occupational level (e.g. intermediate, elementary or high skill). In Chapter 2 I presented the National Qualification Framework (see Table 2.1). Most of my respondents were mainly situated on the higher education and training band. I interviewed them to establish their existent learning pathway, as well as to find out what else they may need or want to know in relation to the rehabilitation practices. I asked them about how and where they learned the practices, from whom, and what has helped them most to learn the practice. I also asked them about training opportunities, and how training is organised in the workplaces, as well as where they go for training, what access they have to relevant training, and I probed in the interview if there are systems support and articulation issues. As indicated here, the interviews were likely to be richly textured, and I followed up on all interviews with further questions and clarifications. Semi-structured interviews often played out as 'guided conversations' rather than structured queries. In other words, although the research would be pursuing a consistent line of inquiry, the actual stream of questions in a case study interview is likely to be more flexible rather than rigid (Rubin & Rubin, 1995). I transcribed all the interviews for the key occupations (see Appendices) and interviews were recorded using my laptop since I did not have a portable audio recorder. At one point on the *16/01/2012 at 11:43am* I had to use my cell phone for an interview with

the safety officer since on that day I did not have my laptop (date and time also in the transcript).

Table 3.3 below shows a full list of all the interviews conducted in the two case study sites:

Site 1 and 2	Why?	When?	Index code
Mine rehabilitation practitioner	To understand how the specialist competence is acquired.	20/07/2011	Career story 3
Botanist	To understand if education and training opportunities are specifically occupational	29/07/2011	Career story 4
Mine manager	To investigate if there is support to enable learning pathways for improved rehabilitation practices.	26/10/2011	Career story 1
Safety officer	To investigate what education and training programmes are available	16/01/20012	Career story 2

3.3.3 Fieldwork observation

By undertaking field visits to the case study "sites", I had the opportunity for direct observations. I focused particularly on workplace aspects of the rehabilitation practices and observed who does what and how they are learning the practices. I obtained permission to 'work shadow' the two occupations that I was interested in on each of the case study sites, and I spent days observing how the employees undertake the rehabilitation practices, focussing on what has been learned (and how) and what still needs to be learned. Being in the workplaces of the employees also allowed me a chance to probe and understand the workplace learning systems, and systems of training and how they function in each of the workplaces, and especially to determine how they are related to the rehabilitation practices under study. Assuming that the phenomenon of interest is not purely historical, some relevant behaviours or environmental conditions will be available for observation (Gross,

Rocha-Miranda & Bender, 1971). Such observations serve as an important source of evidence in this case study research.

Table 3.4 short description of the observations conducted for both sites

Observation	Short description of what was observed	Index code given to the observation data set	Dates
Rehabilitation practices	How they conduct rehabilitation practices. Methods of rehabilitation. Does it contribute towards sustainable practices (development)	OB 1	26/01/2012
Education and training	Identification of education and training effectiveness. Learning pathways involved in the rehabilitation practice (specialist competence) The importance afforded to skills development at the workplace	OB 2	16/01/2012
Safety issues (SHE)	Application of appropriate safety when conducting rehabilitation. Safety talk topics when the shift changes	OB 3	03/01/2012 to 26/01/2012

I conducted a total of three of observations in case 1 and in case 2 sites. To keep track of my observations was not that easy since I was 'hands on' in the field. Every time I got a chance I would sit inside the car and write down what I had observed with regard to the rehabilitation practices that were conducted. See the appendices for a sample of the observation notes I wrote. These observations were all noted down in a note book, with the help of photographs to remember some of the activities, and will be referred to in Chapter 4.

3.3.4 Visual photographs

Visual photographs are a useful means of obtaining additional observation data and are used as a means to capture realities. During my field visits, I captured photographs of different aspects of the rehabilitation practices. This allowed for reflection which enables a researcher to better articulate experiences during interviews (see Appendix 3), using images as reminder notes (Walker, 1993). Such artifacts were captured, collected and observed as part of the field visit. I used photographs in follow up discussions with the key occupations as a way of obtaining further reflections from them on the learning pathways associated with the specific rehabilitation practices and how they have learnt or are learning about the practices. Six photos from site 1 and fifteen photos from site 2 were captured at different blocks of rehabilitation. As such, visual photographs were an important component in developing the cases.

3.4 Data management

In order to manage the large amount of data I collected, I categorised key issues underpinning this study by systematically grouping sources and different methods used when generating the data. Field notes were one of the methods even though they did not offer much help. Since it was difficult to observe and photograph learning pathways, much information was rather gathered through interview transcripts. Photos were taken of the rehabilitation practices in order to see if their practices really contribute towards sustainable development together with documents as "a means of tracking change and development" (Bowen, 2009 p. 306).

One thing that made transcription easier was conducting all the interviews for the key occupations in English; hence there was no translation. I then created a file for storing my interviews, document analysis, observations and visual photographs. I indexed and coded according to sections based on the key occupations and respondents' education history, experiences, and complexities. This helped me to manage the data during the analysis process and also to keep track of the original sources of data during the writing up of the career stories which formed the basis of the case studies.

3.5 Data validity and analysis

Validity is critical in qualitative research because it is often 'naturalistic' in seeking to understand the phenomena in context specific settings, such as "real world setting [where] the researcher does not attempt to manipulate the phenomenon of interest" (Patton, 2001, p. 39). Validity in this research was established through triangulation i.e. the use of multiple sources of data. In addition, the research instruments were piloted and I carried out member checks with the participants to make sure that my interpretations were valid and trustworthy.

Triangulation is typically a strategy (test) for improving the validity and reliability of research or evaluation of findings through comparing data sources with each other. Mathison (1988) elaborates this by saying:

> Triangulation has raised an important methodological issue in naturalistic and qualitative approaches to evaluation [in order to] control bias and establish valid propositions because traditional scientific techniques are incompatible with this alternate epistemology. (p. 13)

Yin (2003) noted that the most important advantage of triangulation is the development of converging lines of inquiry. After collecting data it is always advisable to do member checking as this will help in validating the quality and also ensuring peoples' trust. Member checking ensured that I represented peoples' views correctly.

In this research I do not seek to generalize, but rather to provide depth of interpretation as described by Maxwell (1992) who notes that descriptive validity (i.e. providing thick description) is an important form of validity in case study research.

The use of multiple sources of evidence in this case study approach allowed me to address a broader range of historical, attitudinal, and behavioural issues underpinning and shaping the learning pathways respondents in key occupations relevant to rehabilitation practices. Thick, rich description provides the foundation for qualitative analysis and reporting. Good description takes the reader into the setting being described, so that she/he can understand the phenomenon studied and draw their own interpretations about meanings and

significance (Patton, 2002). Therefore description forms the foundation of the qualitative analysis and reporting (see Chapter 4) and will be distinguished from interpretation as interpretation will involve explaining the findings, attaching significance to certain results, and putting patterns into an analytic framework (see Chapter 5). Patton (2002) notes that it is tempting to rush into the "creative work" of interpreting the data before doing the detailed work of description first (ibid.), hence I focussed carefully on description first as can be seen in Chapter 4.

In compiling the descriptive career stories, I therefore identified three categories that emerged from the career stories and I coded and indexed my raw data to keep track of those three categories. Table 3.2 below shows how the analysis of my findings was approached to ensure trustworthiness. Systematic analysis was very useful for data interpretation and also to further ensure validity.

In Chapter 5 I engaged with interpretation offering a transformation interest showing challenges facing SAQA in its new role after promulgation of the new NQF Act (2008) in the establishment of clear pathways to link three sub-frameworks which influence South African industry and workplace contexts. From the stories I then used critical realism which foregrounds both absence and emergence, and system theory to assess elements of the differentiated system and mechanisms influencing these at workplaces.

 The logic on how I approached the analysis of my work (data) is that with learning pathways research "*career stories provide a way of showing how individuals choose and use work*" (Savickas, 2005 p. 1). I used career stories to show how respondents in key occupations experienced in the workplace reflect learning pathways at different levels of their jobs. This also helped when comparing different data sources. Career stories are recognised as a powerful research tool (Cohen & Mallon, 2001). This was also supported by Savickas (2000) cited in Patton & Mcmahon, 2006) who notes that career stories also reflect change in the structure of work and may also become an agent in the lives of those working and they may also provide an alternative, perspective. As Cohen and Mallon (2001, p. 1) report:

> Career stories illuminate the ways in which individuals make sense of their careers as they unfold through time and space attending to both holistic nature of career as well as to specify career transitions. Further, stories as discursive constructs provide insights into individuals sense-making. Though such insights, the story-based

researcher can build a rich, complex, multifaceted, and integrated picture from the perspective of situated individuals.

Table 3.5 Categories used to construct career stories.

First (1st) category	Introduce the person and their early education history
Second (2nd) category	Learning pathway decisions and experiences related to the sustainable practices
Third (3rd) category	Issues, interesting aspects or complexities etc. related to their learning pathways and sustainable practices.

I used these categories when analysing the data to construct each of the career stories. These were also useful reference for the document analysis which allowed for a broader understanding of career stories from a learning pathways system perspective. Data analysis and coding (using these categories) commenced soon after transcriptions and indexing had been done. For the data analysis to be consistent with my research questions, I kept the research goals in mind throughout, which helped to guide most of my analysis:

Goals:

- To understand the learning pathways associated with key occupations with responsibility for rehabilitation practices of: 1) borrow pits, 2)coal mining
- To explore how the learning pathways enable the development of competence for rehabilitation practices (what knowledge, skills and values are needed) in the selected occupations in the two cases
- To understand the learning system dynamics and factors that enables or constrains learning pathways for improving rehabilitation practices in two cases.
- To identify key access and articulation issues that influence the said learning pathways in the two cases (see section 1.5)

I found it to be useful to work with the data, the categories, and the research goals; this helped me to keep the study focussed and clear.

3.6 Ethics

Bassey (1999) notes that respect for truth, respect for democracy and respect for person is a useful framework for thinking about ethics in case study research. To respect persons means to give weight to their views and their choices and thus this framework helped me to be aware of ethical issues throughout the research project and to accept responsibility for all procedures and ethical issues related to the project.

Respect for democracy involved being aware of a person's right to withdraw from the research. I showed some respect to key occupations that were responsible for rehabilitation practices and agreed with them that they should have the option and free choice to participate in the research and should not be forced to do so.

Framing and pilot testing the research instrument in advance and sharing them with interviewee's maintained confidence in the research process, through making the research process more transparent. I also maintained confidentiality and retained a core focus on the learning pathways question. I decided not to reveal the name of the company or names of individuals as I was working in a competitive environment where information is sensitive. I explained the purpose of the research carefully to all participants and obtained consent to participate forms. Both parties were assured that the research was for academic purposes and would not jeopardise the current trends happening in the mining industry. Permission was obtained from:

- Managing director (first case study)
- Chief operating officer (second case study)
- Respondents in key occupations (participants themselves)

3.7 Conclusions

This chapter systematically described the research methodology and methods, and explained the various steps I undertook when studying my research problems along with the logic behind them. I also explained how the topic of learning pathways influenced the research approach, data collection and analysis. This chapter also provided an overview of how I managed the data and analysed the findings, and how issues of validity and ethics were addressed in the process of this case study research. In the next chapter I present the data, sharing the career stories that I was able to construct, and insights into how these relate to rehabilitation practices and learning pathways that facilitate engagement with, and improvement of these practices.

CHAPTER 4

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

4.1 Introduction

The aim of this study is to establish and identify access and articulation issues associated with the key occupations with responsibility for improving rehabilitation practices of borrow pits and coal mining that influences the said learning pathways in the mining industry. These learning pathways form the basis of the data that will be analysed and subsequently it will be able to make me understand the learning system dynamics and factors that enable or constrain learning pathways for improving rehabilitation practices in two cases. Henning, van Rensburg and Smit (2004, p. 75) state that "capturing data through interviewing, observation, documentation involves research inquiry of data analysis and informs presentation". A description of respondents in selected key occupations who took part in the study will be given in the form of career stories which reflect aspects of their learning pathways. Henning et al., (2004) explain further by saying that the writing up of the career stories therefore assists in the reasoning process on how the learning pathways enable the development of competence for rehabilitation practices in the selected occupations in the two cases and certain issues are clarified during the writing process.

Luhmann (1984) addressed the problems of structural functionalism by focussing on self-reference and contingency in systems. This relates to one of the research goals which explores what knowledge, skills and values are needed in the selected occupations and how these are constructed either through effective functioning of the skills or system through contingency. This chapter comprises a discussion of the findings that emerged from an analysis of the data collected as explained in Chapter 3. This data emanated from semi-structured interviews conducted with reputable respondents in key occupations from case study sites which are addressing the issue of improving rehabilitation practices in the mining industry. The findings reported here are a product of interaction between myself and participants (Temple, Edwards & Alexander, 2006). However, to strengthen insight into the empirical findings based on interviews and observations, I also make use of the documents

which include Environmental Sector Skills Plan for South Africa (ESSP), and Human Sciences Research Council (HSRC, 2009) training manuals and legislation as explained in Chapter 3. In this chapter, I will write up the career stories of the respondents in the selected key occupations in compliance with the principles of qualitative research. Introduction of the person and their early education history; their learning experiences related to the sustainability practices; and issues or complexities (interesting aspects) related to their learning pathways and the sustainability practice will be addressed in each career path story. This chapter uses inductive analysis, as explained in Chapter 3.

4.2 Key occupations and learning pathway career stories

A draft report of the Mining Qualification Authority (MQA) in 2007, which depicts Fundamental Unit Standards (FUS) requirements for qualifications in the mining industry, either for borrow pits or coal mining entails that, despite the challenges that key occupations face with the upgrading of the educational profile (education and training) in the mining sector, the long term option would be to satisfy the requirements of SAQA.

4.2.1 Overview of the key occupations

In this section I explain the logic associated with the selection of the key occupations and the reason and why I chose them. It was necessary to do this before identifying respondents as explained in Chapter 3. Stewart and Shamdasani (1990) and Harrell and Bradley (2009) suggested that researchers should consider all the possible sources of knowledge appropriate to their research questions. I identified four different key occupations relevant to rehabilitation practices, as these were all potential sources of knowledge relevant to my research questions. This provided the starting point for developing understandings to address an existing knowledge gap, such as "incomplete comprehension" (Lotz-Sisitka, 2008) on learning pathways and rehabilitation practices in workplaces. If learning pathways are not contextualised in relation to occupations, a narrow view of learning pathways can exist that is focussed more on preparing people with the technical skills and competencies that are not appropriately situated with sustainability practices, more specifically rehabilitation practices in this study.

4.2.1.1 Career stories of respondents in occupations

In this section I seek to explain and make sense of the career stories of respondents in key occupations as these pertain to learning pathways as explained in Chapter 3, how I chose them and how relevant they were to learning pathways for rehabilitation practices. This required me to interrogate each different aspect of their work adjustment as part of researching their learning pathways or career pathways.

4.2.2 Mine manager career story 1 (Learning Pathways)

Data used to develop this career story includes: Interview with Mr D. (26/10/2011 at 4:32pm); site visits and observations (01/10/2011); on site discussions every morning for the one month, till (01/11/2011), that I was attached to the mine in temporary employment for field work ; job description analysis; questionnaire on his early education history.

4.2.2.1 Early education and career history

Mr D is a 58 year old white male mine manager working in an open cast coal mine for Mbuyelo mining contractors in the Mbuyelo group. He was raised in Mpumalanga province, and matriculated at Middelburg Technical High School. At school he studied Maths, Afrikaans, English, Technical Drawing and Biology. After finishing his matric he became a farmer for a period of about three years, thereafter he went to a Common Wealth College and obtained his first qualification in mining in 1982. The courses he took were all focussed on mining.

4.2.2.2 Learning Pathway decisions and experiences related to the rehabilitation practices

Mr D emphasizes that rehabilitation is actually something that you must learn on the mines and is not really something that you can learn from books. He believes that it needs to be learned practically. He said "then you will learn a lot". He goes on to say "yes" you can learn it from books but it is not the same as on site. He reflected that he did a lot of rehabilitation in his life and he made mention that he was once called to come and conduct rehabilitation by the inspectors at some point in one of the mines because they didn't do it well in Mpumalanga as they wanted to close down the mine. They asked him to come and help

with rehabilitation as he had a lot of experience with rehabilitation. He made a point that "if you don't know what's mining then you can't do rehabilitation but rehabilitation is part of mining".

While I was there doing my "fieldwork", and since I was also temporary a employee, he showed me an open box-cut and elaborated in this way "we gonna do what we call a roll over and we can do rehabilitation as we go along (progressively)". When it comes to training programmes, he mentioned that he has attended a lot of them and amongst them are; house-keeping, safety training and so on, mostly standard training programmes offered by the big mines. He also mentioned training in ventilation, shaft sinking, mining and policies, and gases. He further elaborated that he cannot remember all the subjects he did, but they were 60 in total for him to become a mine manager. Of the interest was the fact that he had never attended rehabilitation training, yet he had become very knowledgeable, training himself through learning-by-doing.

He used this strategy, learning-by-doing, to teach me rehabilitation practices that were underway (at the time I was working). Firstly we opened a box-cut, "he explained that if you don't open out you can't do rehabilitation". He explained further what you have to do is to use a bulldozer and do roll-over and when you take stuff [material] out of your dumper truck it is called back-filling. Through this I could see that not only had Mr D learned rehabilitation practices by doing, he was also willing to teach others how rehabilitation practices should be done through on-the-job mentoring and teaching.

4.2.2.3 Issues, complexities and interesting aspects relating to learning pathway and rehabilitation practices

He explained that curiosity, and learning from people who could mentor him was the most critical thing in his learning pathway. That is how but he learned these practices in his 25years of experience in the mining industry. He also worked at an underground coal mine. He reflects that, there are a lot of skills that one learns from others on site, for example, "go to the office of the inspectors, go sit with those people and ask them what they did". He said further "if you are learning to go on with rehabilitation, I wonder you will become an environmental guy (addressing me), that's for people who work with water licences,

rehabilitation is up to date, wetlands and all those kind of stuff, so you must [go] to the offices of the inspector to get those guidelines to do all your subjects".

He further mentioned that if one wants to acquire the skills he had, the best way to do is to serve many years in mining practice. His skills were obtained through mentoring in the several mines that he has worked for. He thinks it was a calling for him to become a miner. Throughout our interactions he continued to teach me things, showing me the dyke when were inside the pit. He reflected on two of his senior employees named Julian Cassinga (mine geologist-site manager) and Dumisani Ndlozi (pit-foreman).He said *"Dumisani was an excavator operator, I taught him the job and now he's a foreman", and "Julian was sitting in his office playing on a computer, and I could see that he has potential, I took him out of office, and made him a site manager".*

He said he never took short courses as his job is too much demanding. He has a full workload. His job description is to ensure safety in the mine, secondly to lead people and thirdly is to ensure production. He goes on to say that the most important thing about the three main job description areas is "you cannot get out the coal without ensuring safety, and if you do not work safely you will get accidents".

During his long service in the mines, especially underground mining, there were mine captaincy courses at the CTC College in Witbank which he did attend. He reflected more than once that learning from other people really helped him. He cited that his team leader was also influential in his learning pathways, "for that matter he was black", said Mr D. He stated further that team leading skills are very important especially for someone who is really eager to be skillful in his/her field of expertise and he reiterated that "sometimes the best training can be practical".

He mentioned that the company also offers workplace skills planning, but normally they follow the NOSA training calendar, which he said is accredited by SAQA. People who go for that training are learner miners and artisans. He stated that in this area (mine) everybody goes to CTC College and NOSA. He mentioned that if you pass the exams the company pays and if you fail you pay the fees.

"The experience was good!!!!", quoting from the interview when he was reflecting about experience, *"you see there are these inspectors who are good on paper work, but they haven't got the experience, if we go to the site I can see that these guys haven't got the experience".*

4.2.3 Career story 2: Head of education and training (safety officer)

Data used to develop this career story includes: Interview with Mr W (16/01/2012 at 11:43); site visits and observations (01/10/2011); office discussions during induction training for newly employed staff; job description analysis; questionnaire on his early education history.

4.2.3.1 *Early education and career history*

Mr W is a 32 year old white male safety officer working at the open cast coal mine for Mbuyelo Mining Contractors in the Mbuyelo Group. He is employed as the head of education and training which actually deals with induction training, skills development and provides certificates of competence. He completed high school in Ermelo, Mpumalanga province at Leigbrol Technical High School. He took the following subjects; Afrikaans, English, Mathematics, Physical Science, Technical Drawing, and Geography. He then said after obtaining his National Senior Certificate (NQF level 4), he first went to a college in Potchefstroom for N4. He stated "I did electrical engineering there" thereafter he started a SAMTRAC one year course in mining engineering at UNISA, and he is currently completing a degree in Human Resource Management via UNISA.

4.2.3.2 *Learning Pathway decisions and experiences related the rehabilitation practices*

For someone who had not done any training in the mining sector before, he took SAMTRAC courses which mostly specialise in occupational issues training. The courses include safety, health and environment (SHE) and also safety management. Looking back, he reflects that he has never actually participated in rehabilitation practices since his career path was strictly narrowed by electrical engineering. Mr W also mentioned that at tertiary level he never studied anything related to rehabilitation as this was not included in the courses he

took. He says, however, that he knows what is supposed to be done about rehabilitation practices.

In his current occupation, he has participated in extensive short courses which he has attended. They are named according to levels, called COSMOC 1, 2, 3 but he has not completed rehabilitation training amongst those. He said "there is a mining security up-growth course which is useful for improving rehabilitation practices and also for skills development".

He states that such short course training has helped him to head the education and training for Mbuyelo mining contractors falling under the Mbuyelo Group. He said one needs skills to become knowledgeable and experience with long service in the mining industry to be competent.

His skills, he said came from his previous work experience with other mines where he worked for a minimum of three years under the supervision of David Smith. Under David Smith, he attended short courses of COSMOC 1 and 2 but he is not sure if there is a level 3, since he only did COSMOC 1 and 2. COSMOC 1 is a chamber of mines safety officer certificate and COSMOC 2 is the same except that you will be issued with a Diploma.

These short courses were being offered by NOSA for SAMTRAC and PO consultant, for a period of two weeks. The content of the course was focussed on safety management (education and training), illustrating how to conduct induction training, procedures, policy and the whole system around occupational quality. He stated that these short courses are accredited by SAQA. Before starting on a new job he had to do induction training and thereafter undergo a medical examination to verify whether he was a good candidate to work in the mines. He stated that this training was provided by David Smith. He explained that there was training every day, formal and informal training based on a plan of what to do for that particular day and so on. He mentioned that he had learned from other people, mostly from David Smith who was his mentor.

4.2.3.3 Issues, complexities and interesting aspects relating to the learning pathways and rehabilitation practices

Mr W seemed to understand what was meant by learning pathways, but said that he "doesn't know how to express and explain it", but "in order for people to become what they want to be at the managerial post level, they will have to spend time with people with the right knowledge and experience in the mining industry because that's the only way to learn". He said that people also had to "learn to teach yourself". When it comes to knowledge needed in terms of education and training in the mining industry he said that "as an individual at a workplace, you must always assess the situation". He gave an example of himself as the head of education and training who offers induction for every employee in the industry. He said after training his workers, "I have to assess them to ensure if they are fully educated to avoid injuries and incidents".

Mr W's job description expects him to make sure that the safety system is implemented and managed by facilitating competence amongst employees through training. He emphasized the point that, it was through working with people who have got the necessary skills that one's learning pathway develops and in his case it helped him to develop skills. Most influential to his learning pathways was his previous employer, who took his learning seriously and supported him through practice, and also by sending him on relevant training programmes

4.2.4 Career story3: Mine Rehabilitation Practitioner career path story

Data used to develop this career story includes: Interview with Mr R (20/07/2011 at 06:48pm); site visits and observations during the course of consulting inspecting; documents; job description analysis; questionnaire on his early education history.

4.2.4.1 Early education and career history

Mr R is a middle aged, mature black man, born in 1977 working at Shumani SHE Specialists. He went to Matswake Secondary School which is at Ga-manaka, Limpopo province. He laughed as he could not recall the subjects that he took at the secondary level; he later

recalled them to be English, Northern Sotho, Biblical Studies, Biology, Agriculture, Afrikaans and History. He then went on to study BA Psychology at the University of Venda from 1996 till 2009. While at the tertiary institution he took the following courses: Psychology, Anthropology, English, English learning practice (ELP), Statistics, Mathematics and Northern Sotho. After graduating with his BA Qualification, he again registered in 2005 for a Diploma in Mining Impacts and Rehabilitation at the University of Venda. He reflected that he did not go for any training programmes other than these formal qualifications. His current involvement with rehabilitation practices is to compile Environmental Management Plans for operation of mining sites and to recommend closure objectives. He explained mostly what we need to know is (in order of importance): "(1) the desired state of each rehabilitation programme is to retain the land prior to the mining operation. Though we can't reinstate the divested area, we make recommendations that the area should promote agricultural growth, and (2) Storage of water for stock farming".

4.2.4.2 Learning Pathway decisions and experiences related to the rehabilitation practices

After graduating with his Diploma in Mining Impacts he worked as a Junior Environmental Consultant at Environmental Impact Management Services (EIM) and that is where he acquired and grasped the knowledge of rehabilitation. "With skills on rehabilitation practices there are no trainers for one to become a specialist or practitioner" he said, and he gave an example of, *"if you compile environmental assessment which involves rehabilitation for specific activities, no necessary skills are required"*. He acquired all these skills through working under the supervision of project managers (senior employers). He did not complete any short courses. His skills were, however, shaped by attending International Association of Impact Assessment meetings (IAIA meetings). He explained that the IAIA meetings can be seen as short courses as he said "*Every environmental service provider is invited for these meetings, the period of the conference it depend on the reviews of the projects, they can be an annual thing, three (3) months etc. On the content of these meetings, they talk about Environmental Management Plan, Strategic Environmental Assessment, Environmental Impact Assessment, Integrated Environmental Management,*

Waste disposal etc". Furthering his studies seems to have played a major role as he says *"I'm currently studying towards my honours qualification".*

4.2.4.3 Issues, complexities and interesting aspects relating to the learning pathway and rehabilitation practices

Mr R's job description expects him to compile assessment reports, undertake EIA studies like scoping, compile EMP for linear development (access roads, pipe lines and power lines); all of these are part of rehabilitation at the borrow pit development sites. Completing mining permit applications and prospecting rights, and making sure that rehabilitation is implemented, are part of his work. He said that someone who would also want to become a practitioner in this occupation should have a background in environmental training, and he said preferably a qualification from a recognised tertiary institution. He highlights that even knowledge of "environmental legislation" helped him to become a successful rehabilitation specialist as he had to know both national and international legislation including NEMA and EIA regulations and other statutory (National Environmental Management Waste Act , National Environmental Management Air Quality Act, National Environmental Management Biodiversity Act, etc) legislation. For someone to be able to grasp the knowledge needed he recommends that "someone who is still fresh and is coming from school must embark on an internship or learnership" and get "years and years of experience". He called this "hands on job training". He said that such training is also offered in their company in the form of internships and even workshops. He said that he "had fun during those days when he was still a junior".

4.2.5 Career story 4: Botanist story

Data used to develop this career story includes: Interview with Mr M (29/07/2011 at 2:21pm); site visits and observations during the course of consulting inspecting; documents; job description analysis; questionnaire on his early education history

4.2.5.1 Early education and career history

Mr M is a Botanist. He is a 25 year old young black South African working for Shumani SHE Specialists under the environmental services division. He hails from Limpopo province, where he attended the public primary school, Tshirunzanani then Tshinavhe secondary school in the same Vyeboom rural area. At school he took Tshivenda, English, Maths, Physical Science, Biology and Agriculture. Since he got an exemption he was highly influenced to go to a higher learning institution to pursue his BSc. He was then enrolled at the University of Venda in 2006 and in his first year he studied Maths, Physics, Statistics, and Diversity of Life, Cell Biology, African Civilization and Ecology. In the second semester of his first year he learned about rehabilitation in an ecology module where the topic to *"rehabilitate disturbed and degraded land in the abandoned nature reserve"* was discussed. Through his undergraduate programme, he also attended training programmes such as the "Wilderness School" at Laphalala Nature Reserve in September 2008. In 2009 he went as far as to attend a programme offered by the University of Cape Town at the Centre for Cell Biology (CIB) and NRF (National Research Foundation). The training programme was called Biodiversity Academic Internship (BAI). Looking back he reflected on the importance of the training programme as it provided him with a very good chance to explore and understand rehabilitation practices across the environmental and sustainability discipline.

4.2.5.2 Learning Pathway decisions and experiences related to the rehabilitation practices

Mr M said Prof Steve Hockey and Douglas (he forgot his surname from the UCT Centre of Excellence) taught him *"Invasion biology, eradication of invasive species, marking the pit fall, team building, measuring biodiversity and its impacts"*. This influenced his decision to complete an honours degree in Botany, straight after his undergraduate degree, during which he became interested in borrow pits rehabilitation and site establishment rehabilitation. Reflecting on what he learned during those training programmes he notes that *"the importance of rehabilitating degraded lands is to achieve the objective of having a sustainable environment and sustainability equity".* Attending those training programmes gave him a background and urged him to complete his honours in Botany. As a young black natural scientist he jokingly first made claims that he had taught himself all this

rehabilitation practices knowledge. He then said his boss is more experienced in this field and at the time he was employed, he was also taken for induction training on the environmental management aspects, and that the he had also learned from his boss's experience and the induction training.

4.2.5.3 Issues, complexities and interesting aspects relating to the learning pathway and rehabilitation practices

Mr M reflected that skills and knowledge are important for rehabilitation as he stated that to be skilful one *"must have botany, environmental management, integrated studies of management, knowledge of mining, and be well equipped to identify the importance of conservation areas and botanical areas".* Using his knowledge, and working with experienced and skilled employers, his first exposure to such practices in 'real life' provided him with further skills on the opening of a borrow pit as an extension of an ongoing project obtaining borrow pits material (gravel) in Delmada near Polokwane. The project was for the municipality, and he notes that in his first encounter with the borrow pits he managed to rehabilitate it to *"become a botanical and conservation area of which now has developed a wetland of which is now more conservational importance, actually in the middle of a borrow pit there is lot of botanical plants and lots of indigenous plants".* After gaining some experience he expressed himself to be an experienced person in both botany and ecology as he studied them. He is still continuing with his studies. He did not want a mentor and said *"Some of the things no one has to teach me, I have to teach myself".* He attended short courses at the Laphalala Wilderness Nature Reserve School where he learned so much related to rehabilitation practices such as vegetation survey, archaeology, geology, and the impacts of mining. The period of the short course was two weeks. He could not remember further details of the short course, but mentioned that it was accredited by the South African National Parks, the Department of Education, SETA but he was not sure about SAQA.

His job description as a junior environmental consultant in the company is to apply for environmental authorization for projects, develop environmental management plans and conduct basic assessment and also contribute to environmental management systems development. He said he did not go for on the job training since he studied most of the

issues at tertiary level. Good guidance was provided by his lecturers Paul Forche and Foorde and he learned a lot from those two people especially two courses on biological assessment and water resource management. Challenges in the botany field gave him the courage to be skilful, and he said it was important to know your stories with regard to Botany, Environmental Management, and Zoology and Conservation Biology. To be able to become a practitioner of this occupation, knowledge that you need is to learn to advance yourself. He says one has to ask: "where do I start, what do I need to do, what do I have, those are the key principles".

The company that he works for also offers training for Occupational Health and Safety Induction, Environmental Awareness and Training, and Social Facilitation. He stated that he was a little bit confused about who goes for training since the company also offers training to others, and the contractors pay the company. On the issue of workplace skills planning he referred me to the Managing Director since it is dealt at the top level but he hinted that rehabilitation issues should be included in the skills training programmes since there must be site rehabilitation. He said there was FET training on rehabilitation but he was obviously not FET material. He said that so far the experience in his job was challenging as the new discipline of environmental management has many new challenges every day to understand and respond to.

4.3 What the sector "says" about learning pathways for rehabilitation practices

The previous discussion in section 4.2 on career stories shows that a unit of analysis focussing on the cross overs in actual learning pathways related to occupations can provide a rich picture of 'learning pathways' and how they are constructed in the context of mining rehabilitation practices. Such a unit of analysis potentially provides a more interesting way of understanding articulation in the context of learning pathways, notwithstanding it being more complex and notoriously difficult to research (Lotz-Sisitka & Ramsurup, 2012). Learning pathways using this unit of analysis (career stories) indicated that there are different knowledge construction influences in learning pathways related to rehabilitation practices. The stories showed both the influence of experience in learning pathways construction, as well as the influence of good quality education and training, as well as

mentoring and 'cross over' learning opportunities (workplace to course). In the next section, I consider how such aspects are dealt with in policy, strategy and workplace documents.

4.3.1 Policy documents

Exploring what the differentiated system elements are of learning pathways relevant to rehabilitation practices, and examining how differentiation of learning pathway elements are related to changes in the environment, more specifically the need to adapt to and learn new knowledge, skills and practices for improving rehabilitation required an examination of policy documents. As mentioned in Chapter 3, I reviewed a number of documents including the Skills Development Act of 1998, the Deputy President speaking in Pretoria, September 2012 (mid-term report of the Human Resources Development Council of SA, HRDCSA), the SAQA Act No.58 of 1995, the National Qualification Framework Act No.67 of 2008 and the National Environmental Management Act No.102 of 1998 (D1-D12, all documents are fully referenced in Chapter 3). Examining these policies documents allowed me to understand how learning pathways and workplace learning can be strengthened for rehabilitation practices. For example, the Skills Development Act, 1998 (RSA, 1998) indicates that it intends: "to provide an institutional framework to devise and implement national, sector and workplace strategies to develop and improve the skills of the South African workforce" (D1:1). The National Environmental Management Act No.102 of 1998 (RSA, 1998) states that "to ensure that South Africa effectively manages the environment for the benefit of current and future generations, according to the Bill of Rights in Section 24 of the Constitution, there is need to give attention to skills needed to fulfil mandates" (D5, pp. 1-5). The 2012 mid-term report by the Deputy President articulated how low skills development can be attributed to weak education by saying "the skills development problems in our country could be attributed to the weakness in the education and training system, starting from early childhood development and continuing right through the schools and post-schools system and on-going workplace professional development" (D2, p. 1). These all show a strong political commitment to skills development in South Africa.

Education and training opportunities (system opportunities) for workers at occupational level has been related to lack of training-based learning pathways, which the National Qualification Framework seeks to address through creating a "single integrated national

framework for learning achievements that will be facilitating access to, and mobility and progression within, education, training and career paths. Enhance the quality of education and training" (D4, pp. 1-3). All the documents emphasize that education and training in workplaces should be geared towards broader societal transformation to a more sustainable and equitable future i.e. to enhance workplace and lifelong learning and also the factors which enable learning pathways for improving these practices. The Deputy President's mid-term report reads thus: "the strategy seeks to ensure universal access to quality basic education that is purposely focussed on dramatic improvement in skills to meet demands of the growing economy. The Human Resource Development Council of South Africa (HRDCSA) adopted a five-point plan based on strengthening and supporting Further Education and Training colleges to increase access, production of intermediate skills and professionals, and foundational learning" (D2, pp. 3-4).

Skills development in South Africa has been identified as one of the main impediments to reaching the stated economic growth targets of the state. The SAQA Act (No.58 of 1995) was passed as law in October 1995. This authority was established with the express purpose of establishing, implementing and monitoring the National Qualification Framework. In the environmental sector, the need for life-long learning (and hence open learning pathways) is also driven by the need to address rapidly emerging environmental issues (such as rehabilitation in this context), and implementation of environmental policies, many of which are new (such as policy governing rehabilitation practices in mining industries). SAQA will have to "maintain the national framework for standards generation and quality assurance. Maintain and develop the NQF level descriptors. Maintain and develop the register of national qualifications" (D3, pp. 2-4).

These issues were also prioritised by other policy documents relevant to the environmental sector such as the National Environmental Management Act No.102 of 1998, which stated that: "to implement international agreement on the environment, to provide leadership, policy and institutional frameworks; and to facilitate active service delivery in the environmental sector in relation to the national mandate. There is need to give attention to skills needed to fulfil the mandate" (D5, pp. 2-5). Learning pathways has been integral in the learning systems dynamics of the South African NQF, structuring learning pathways is seen to provide mobility for workplace learning, because learning pathways allows amongst

other issues to "accelerate the redress of past unfair discrimination in education, training and employment opportunities [and to] contribute to full personnel development of each learner and the social and economic development of the nation at large" (D4, pp. 4-5).

The scope of environmental variation within the system itself (which may include variation of individual biographies/or *career stories'* as noted above, section 4.2 in the context of two different rehabilitation practices, and the learning pathways of four key occupational employees within these cases) related to the wider context of 'work and learning' (Lotz-Sisitka, 2008) governed by the NQF Act in its revised version of 2008. The new NQF Act makes provision for articulation within and between learning pathways in order not to only advance the objectives of the NQF, but also to ensure that the young are not subjected to dead-end qualifications.

4.3.2 Document analysis of workplace documents

This section reports on a second phase of document analysis focussing change oriented workplace learning and rehabilitation practices. In this section the sector's responses to building on existing strengths and providing new opportunities for improving rehabilitation practices in the mining industry responding to genuine NQF structures and processes is considered. How rehabilitation practices can be learned in workplaces demands new forms of learning and agency/or learning that is change oriented. In order to ensure quality education and training in terms of the NQF, it is necessary that skills acquisition must take place. As these practices are new, they often challenge the status quo in workplaces and in society more broadly.

Environmental Sector Skills Plan (DEA, 2010), Human Sciences Research Council research Report (2009), Department of Higher Education and Training (Based on International Labour Organisation), Training manual (APCOR), Mining Qualification Authority (Education, Training and Quality Assurance 2003) and Sector Skills Plan for the mining and mineral sector (2011-2016) documents outlined in Chapter 3 (document analysis of workplace documents) noted that 'lack of career path/or learning pathways was consistently cited as a fundamental constraint in the retention of both new and experienced staff, hence well-planned and

transparent career options and development paths were non-existent, pressing limited opportunities for advancement'. Education and training programmes are a significant factor that can potentially shape and enhance workplace learning (D10, p. 6).

The National Skills Development Strategy III is the latest national strategy developed to guide sector skills planning (Environmental Sector Skills Planning and Sector Skills Planning for Mining and Minerals). The two documents, ESSP (D6) and the Sector Skills Plan for Mining and Mineral Sector (D12) both indicate that, support systems need to be in place in the skills system to ensure sustainable use of natural resources and also those support systems must allow for vertical and horizontal learning pathways for improving sustainability practices. These are education and training programmes, policies, strategies, funding, professional capacities, workplace skills training processes, opportunities advancement and so on. Hence, these issues require 'articulation' to understand learning pathways. For example, the ESSP document (D6, p. 5) states "It is encouraging to note that South Africa's education and training institutions and systems are beginning to integrate environmental education and training issues into range of disciplines and programmes". It further provides guidance on "improving environmental sector skills development planning and implementation within the national education, training and skills development system" (D6, p. 3). The Sector Skills Plan for the Mining and Minerals Sector recommended the following, there is need "to improve health and safety standards through education and training in the mining, identify a set of sector specific (skills development) objectives and goals that will meet sector needs, economic or industrial growth strategies, and meet scarce and critical skills needs in the sector" (D12, pp. 1-3).

Another key education system feature mentioned in all of the documents was the issue of funding of training. All the documents state that there is need to ensure that specific occupational workers gain access to; and make use of funding when it comes to education and training. In this regard, the Human Science Research Council (D7, p. 6) states that "A lack of funding to sponsor possible promotions was cited as a more recent occurrence". The document goes on to discuss this issue further with reference to the higher learning institutions when it states that "Even where there are some progression paths, for instance at universities (lecturer, senior lecturer, associate professor, professor etc), the lack of

demonstrable financial rewards often rendered advancement insignificant. Thus, many university lecturers engaged in consultancy work to supplement their salaries". The HSRC documents observation raises an issue of an apparent lack of organisational value placed on knowledge in career pathing through funding. The Skills Development Act of 1998 (D1, p. 4) raised objectives of workplace learning funding which "provide for financing of skills development by means of a levy-financing scheme and a nation skills fund". The National Qualification Authority Act No.67 of 2008 (D4, p. 2-4) supported the above policy by saying that the NQF should "Facilitate access to, and mobility and progression within, education, training and career paths [and]. Accelerate the redress of past unfair discrimination in education, training and employment opportunities". The question for this study is how this relates to rehabilitation practices in the NQF.

The Mining Qualification Authority is a registered Sectoral Education and Training Authority (SETA) in terms of the Skills Development Act of 1998. Hence the environment is now beginning to be articulated in the MQA Sector Skills Planning document. The environment is a cross-cutting issue relevant to all SETAs, as in the ESSP reported:

> There is no dedicated 'environmental' Sectoral Education and Training Authority in South Africa and the environment needs to be integrated into all SETAs. As yet there has been no comprehensive skills development planning or analysis of skills development issues in or for the environmental sector (p. 5).

The MQA promises to "promote the culture of learning in the mining industries. Assure the quality of education and training in the mining industry without itself being a provider of education and training. [and] Facilitate strategic human development in the mining industry" (D7, pp. 5-7).

The documents also focus on environmental and sustainable development learning pathways. The Human Science Research Council and the Organising Framework for Occupation and the Department of Higher Education and Training (D7; D9; D10) states that "The lack of career paths was consistently cited as a fundamental constraint in the retention of both new and experienced staff". The issue of occupation is also emphasized, and the Organising Framework for Occupation gives codes for each of the key occupations and describes each occupation and what it is expected of it, for example a "Botanist" occupation includes competences such as "Design and carry out environmental impact assessments to

identify changes caused by natural or human factors providing advice to governments, organizations and businesses in areas such as conservation, management of natural resources, the effects of climate change and pollution" (D4, p. 1). These are important competences for rehabilitation practices. The occupational description of mine manger is "Overseeing the selection, training and performance of staff". (D10, p. 1).

The occupational description of the safety officer includes; "Develops, implements and evaluates risk management policies and programs, trains employees in occupational health and safety procedures, monitors and audits the workplace, and records and investigates incidents to ensure safe and healthy working conditions. (D10, p. 2), and for the environmental practitioner occupation "Studies and develops policies and plans for the control of factors which may produce pollution, imbalance or degradation of the environment". (D10, p. 3). These occupational descriptors are important as they are used by SETAs e.g. MQA to structure training allocations for occupationally directed training. They can help the environmental education sector establish provisioning for clear learning pathways to link sub-frameworks which influence South African industry and workplace contexts.

The HRSC reveals that "there was also a view that instead of considering managerial work as the only progression path, alternatives should be considered in providing older professionals with alternative, perhaps horizontal, pathways, which may include interesting projects that are challenging and multi-disciplinary" (D8, p. 1). A good example of this was found in the story of the rehabilitation practitioner in section 4.2.4 career story 3 "After graduating his BA Qualification, he again registered in 2005 for a diploma in mining impacts and rehabilitation at the University of Venda". Such approaches are recommended by the HRSC, who also state that "the Centre for Scientific and Industrial Research was consistently quoted as having an extensive career pathing system and provided clear paths of progression". (D8, p. 7). The ESSP notes that understanding the occupational frameworks helps to "sets objectives for Human Capital Development Strategic Planning for the environmental sector, and provides guidelines for Human Capital Development Planning" (D6, p. 4). Due to the increase in to number of accidents in the mining industry, the MQA and DHET have put more emphasis on workplace alignment in skills planning for the sector (D8 & D11). These documents state that there should be improvement in health and safety

standards through education and training in the mining sector, and that there is need to evaluate foreign qualifications, undertake research, and review qualification and learning achievements in the mining industry to improve health and safety standards through proper training and education (D3: 4, 9; D7: 1; D12: 1). These documents state that the training should be programme specific (practical), promote quality training (properly trained) and be situated in relevant their skills/ career pathing (D11, pp. 1, 2, 3; D8, pp. 2, 8; D12, pp. 4-7).

In the case of this research, the context of learning pathways associated with mine rehabilitation practices draws on the system of providing for training and its sub-differentiated systems i.e. Umalusi, CHE and QCTO. A number of documents (D7, D8, D10 & D11) indicated, the mining industry should combine leaning pathways (academic trajectories) either formally or informally. By doing this, for example "appropriate forms of training for managers may require consideration of short courses in "top up" skills as well as a customised postgraduate degree in the longer term in conjunction with relevant service providers" (D8, p. 2). SAQA and NQF Act (2008) aims to provide for the establishment of clear pathways to link three sub-frameworks which influence South African industry and workplace contexts. As mentioned in section 2.1 these are the schooling and FET college sub-framework (Umalusi); the trade occupation and education sub-framework (Qualifications Council for Trade and Occupations-QCTO); and the higher education sub-framework (CHE).

In the case of the mining industry, it is likely that senior personnel involved in rehabilitation practices would have higher education qualifications, but would also need to undertake 'in-service' training to update themselves on new environmental legislation or on new types of rehabilitation practices. Thus, their learning pathways would cross the NQF sub-framework a perspective which appears to be supported in the documents reviewed for this study (D8, D10, D11 & D12). The MQA is a critically important institution facilitating such learning pathways. They "Liaises with the SAQA, or other bodies, persons or institutions concerned or directly affected by education and training in the mining industry" (D12, p. 8). The MQA also "keeps a record of learning for people in the mining industry, perform any function that must be required by the SAQA in terms of the Authority's registration or Accreditation" (D12, pp. 9-10). The Human Science Research Council suggests that "there are more fundamental issues underpinning a discussion of career pathing" and that SETAs such as the

MQA need to take up such discussion (D8, p. 8). In order to achieve this, the MQA suggested the need to "determine skills development priorities after an analysis of the skills demand and trends, and supply issues within the sector, identify a set of sector specific (skills development) objectives and goals that will meet sector needs, economic or industrial growth strategies, and meet scarce and critical skills needs in the sector" (D7, p. 2-3).

The MQA Sector Skills Plan has been developing South Africa's resources in a way that is sustainable and does not degrade environmental quality. The legislations exist for rehabilitation practices (to inform new development) and restoration of spent mines (DEA, 2010). In the Sector Skills Plan, the MQA made provision for the Mining industry to comply with legislation and therefore needs to develop and cultivate the skills necessary for environmental management and rehabilitation training. In addition, companies in the mining sector need to become involved in rehabilitation training and they need associated skills, said the MQA SSP. The importance of skills that will support rehabilitation practices was emphasized in Chapter 2 as the skills in rehabilitation training are becoming increasingly important in the mining industry.

4.4 Field observation and visual photographs relevant to learning pathways of key occupations.

Within the everyday destruction of the environment in the mining industry, observing and taking photographs show whether their practices contribute to sustainable development through education and training. As mentioned in Chapter 3, it is difficult to visualise learning pathways. Photographs, however, were used to capture rehabilitation practices as these reflect some aspect of the learning. A number of abandoned mines have been reported in South Africa mainly because they cannot afford the cost of rehabilitation and/or they see it as unimportant because they will leave the site. Highlighted in the previous chapters (specifically Chapter 2), with the growing demand for rehabilitation practices in the mining industry, environmental education and education for sustainable development in the form of education and training has the challenge in responding to the risks of modernity as some of which manifest in unrehabilitated mines. As explained in Chapter 3 I conducted observation on rehabilitation practices relevant to learning pathways. OB 1 mainly looked at

rehabilitation methods used, OB 2 focussed on the education and training relevant to rehabilitation practices; and OB 3 focussed on safeties as part of workplace learning.

In a nutshell, all these form part of learning pathways for improving rehabilitation practices. Preparing for rehabilitation in the mining industry is notoriously complicated as shown in Table 2.2 and Table 2.3 in Chapter 2. The career story of a mine manger section 4.2.2 also explained some of the methods of rehabilitation in the mines.

4.4.1 Rehabilitation practices

OB 1: Even before rehabilitation starts, mine operators construct stockpiles of three different types. Thereafter, they open a box cut of 60 by 100 metres within a trench mark. On the site I observed there were three different types of stockpiles; namely, topsoil, soft material and overburden. The piles showed compliance with the DME standards of not exceeding a 30m level stockpile. There are basically two types of rehabilitation which were being applied; namely, in tip and roll over. I learned this from a Mine Manager when interviewing him. When this type of rehabilitation is performed there is a box cut which is left open so as to dump back the materials from the stockpiles. The overburden is mostly comprised of different materials (complex rock material) which range from; shale, sandstone, and limestone. It is of paramount importance to separate it from other stockpiles because of the potentially severe impacts on the environment. The stockpiles have an effect of stimulating adverse effects by stressing the environment through acid mine drainage commonly known as AMD. This impact has been reported in a number of cases and is believed to be the second biggest environmental threat in South Africa, apart from global warming and climate change (Edmeston, 2010).

More awareness is needed to address these issues and this could be achieved through environmental education, thorough relevant knowledge, skills and value (competencies) in the mining industry gained through learning pathways including practical skills and work related experiences for competencies.

Below are the photographs of stockpiles

Figure 4.1: Topsoil stockpile

The top soil stockpile (see Figure 4.1) is made up from the uppermost layer of the soil covered and has a higher organic content than the soft material, and is relatively thin as compared to the following layer. Topsoil is the most fertile portion of soil, as it is nutrient rich, contains micro-organisms and seeds which are most important for vegetation. This portion of soil is very useful for rehabilitation practices, hence it should not to be contaminated and mixed with other materials.

Figure 4.2: Soft material stockpile

The soft material stockpile (see Figure 4.2) is commonly known as a 'mineral layer' since minerals are leached from the top soil. Soft material is typically brownish and/or red in colour; this is because of the clay and iron oxides. It should be separated from other stockpiles to avoid contamination with heavy metals and leaching.

Figure 4.3: Overburden stockpile

The overburden layer (see Figure 4.3) is found below the soft material but above the aggregate deposit. It contains many complexes of un-weathered materials and is often known as 'waste' rock. It becomes useful when filling and contouring material for reclamation.

Types of rehabilitation practices being practiced.

As mentioned above, two rehabilitation practices were being applied. In the career story of a mine manager, he mentioned "roll over and in-tip". He said to me "we gonna do what we call a roll over and we can do rehabilitation as we go along" (progressively).

Figure 4.4: Roll-over

Figure 4.5: Roll Over

Both photographs display the roll-over method of rehabilitation practices (Figures 4.4 and 4.5). This is, however, not a final stage of rehabilitation but is rather a first part of the rehabilitation process. These photographs show a blasted box cut, and instead of loading this overburden to the stockpiles, they decided to use a dozer to push the material into an already mined out box cut.

This method also reduces acid mine drainage, since rehabilitation is performed or conducted simultaneously on site, avoiding double handling, despite the mining and rehabilitation been undertaken concurrently. The box cut consists of an open pit void which is approximately 30metres deep, partly filled with ground water. The water level in the pit is not allowed to rise since it is pumped to the water tanks to spray the roads to suppress dust. Some is pumped out of the mined bituminous coal to the natural environment. The photographs below (Figure 4.6) show water from the mine being pumped out.

Figure 4.6: Water being pumped out of the pit

Figure 4.7: Water level before pumping

Figure 4.8: Decant contaminated water from the coal site

Figure 4.9: Decant water from the coal site to the stress free environment

The photographs above (Figures 4.6 and 4.7) show water pumped into the fresh environment. This is not sustainable since the water might have some harmful chemical components or heavy metals that could destroy living organisms.

The second method of rehabilitation practices used is the in-tip. This method is used inside the pit and involves loading of waste rocks to another already mined out box cut. It is fast and cost-effective in the sense that the mined out box cut is in close proximity. Time is considered as the rarest commodity when conducting rehabilitation; in-tip is therefore advantageous. The photographs below (Figures 4.10, 4.11, 4.12 and 4.13) show this method.

Figure 4.10: View of the south in-tip

Figure 4.11: View from the north in-tip

Figure 4.12: An open space where the in-tip is taking place

Figure 4.13: Another example of in-tip filling.

Sustainable practices are both complex and challenging to get right, especially in this context (mining industry). Figures 4.10 to 4.13 show that the in-tip rehabilitation practice is slightly different from the roll over since the dozer is only required for maintaining the level of the surface. In Figure 4.11 a dozer is shown pushing the material to maintain an even surface. In most cases during the day shift there will be a 'teller man' who will be directing the dumper drivers where to in-tip the material safely, he also counts the number of loads in tons. Rehabilitation (in-tip) will therefore involve levelling after the filling of the voids.

All top soil will be utilised as a growing medium in the rehabilitation process of the site, in other words it must be spread over all prepared areas and revegetated with seeds. In Chapter 2 it was mentioned that there is a need for skills such as 'Biotechnology' to be able to produce genetically modified seeds which can adapt to these devastating conditions polluted by chemicals and heavy metals. A botanist can only do a little of this, which is limited to a certain scope (see Appendix 2.5; D9, p. 1).

4.4.2 Education and training

OB 2: education and training programmes in the mining industry are needed to ensure competence in the environmental sector (DEA, 2010). From the first day of my "hands-on fieldwork" which started on September 1st 2011, I was subjected to 'induction training'. This is the training provided to new employees by the employer in order to assist in adjustment to their new job tasks and to help them become familiar with their new work environment and the people working around them. This type of training also outlines the basic overview of the company and its services to contextualise the new employee's role in the environment. The safety officer who heads the education and training together with his safety representatives are in charge of this training.

The training also determines whether the employee is competent or not and the report is kept confidential until the employee decides to quit. I observe this on 16/01/2012 at about 11h00 before interviewing a safety officer, (I interviewed him at 11h43). There was a new employee who was undergoing induction training in the office; he was being trained to handle a machine responsible for rehabilitation practices. The man did not understand the training; and the safety officer asked him *"are you competent enough for this job"* he replied *"no sir"*. Without me he could have lost his job, I humbly asked the officer to give him a test

and he passed the test. He told me that, "*my previous employer offered training but he does not want to give us certificates of competence, because we will go and look for other high paying jobs*". However, this is the commonly used induction training regarded as training provided to new employees to acquaint them with the job requirements and practical issues. As part of the process of gaining skills and knowledge at work, induction is regarded as a work based learning. From the interviews and observations the role of induction training in rehabilitation practices is part of learning new skills and competences or with the need to acquire new information in order to improve job performance.

4.4.3 Safety issues (SHE)

OB 3: The issue of safety is of paramount importance in the mining industry. It is one of the tasks of managers to ensure safety when conducting rehabilitation, as indicated in the OFO codes and details outlined in D10 (see Appendix 2.5) which state that the mine manager should ensure safety, as one of his tasks is "*Coordinating the implementation of health and safety requirements*". Each and every day before the shift starts, there has to be a safety talk and everybody has to sign to confirm that he/she has attended that talk. It also serves as a warrant to enter into the pit. Two shifts are being utilised i.e. day and night shift; in each shift employees have to elect one individual who will lead the talk and who can translate from English to their vernacular. In time workers from the workshop (mechanical engineers and diesel mechanics) also started having their safety talk using it also as a general safety meeting. This was because they were required to check up on the trucks and other machines before operators start with the business of the day.

The photograph below (Figure 4.14) shows a safety talk and the signing of a record book, which grants them a permit to enter the pit.

Figure 4.14: Safety talks

One incident of the dislocation of a dumper was reported during the in-tip method of rehabilitation on the night shift. When I asked how a dumper bucket can be dislocated from its position, their argument was *"the surface was uneven and in-tip is too risky at night"*. Unfortunately I could not get photographs of the dumper since I was only reporting for day shift and the machine had already been towed out for repair. Figure 4.15 below shows an uneven surface while preparing for rehabilitation practices.

Figure 4.15: Uneven pit surfaces

The above Figure 4.15 shows what pit roads and surfaces look like when they are busy preparing for rehabilitation, especially for methods like in-tip, when a dumper bucket can fall due to the weight of the material being handled.

4.5 Borrow pits complete rehabilitation photographs

The following are the photographic records of complete rehabilitation of borrow pits. They are based upon the completed site closure activities and information provided in this research. It was concluded with given evidence that the borrow pits were well rehabilitated and they are self draining as indicated in the contours (see six photos below).

Figure: 4.16. The physical stabilisation of soils to prevent soil loss as a result of erosion was ensured and the site was rehabilitated and returned to a safe stable site. Final drainage of the site was ensured so that it does not adversely affect the neighbouring properties.

Figure: 4.17. Amongst other rehabilitation practices criteria, unacceptable health hazards were eliminated ensuring that public safety is not compromised. Reclamation of this mined area was ensured.

Figure: 4.18. This picture shows that the borrow pit area is backfilled with extra materials to eliminate the depth thereof.

Figure: 4.19. Reshaping of this borrow pit land was blended into the surrounding landscape to reduce the likelihood of erosion. This allows for natural drainage patterns to be re-established.

Figure: 4.20. Top soil is reinstated to speed re-growth of vegetation in the area. A visual inspection needs to be conducted at least bi-annually to monitor re-growth of this borrow pit site.

Figure: 4.21. This shows watering of seeds after rehabilitation to reduce dust.

The specialised competence of knowledge, values or skills that are needed for these practices as seen through observations will need to cover aspects such as soil handling, revegetation, soil nutrients, fauna return and success monitoring. These key occupations (four) responsible for rehabilitation should be able to adapt when planning for rehabilitation practice objectives.

4.6 Conclusion

This chapter shared gathered data analysed from different sources. The chapter started with the learning pathways stories of four respondents employed in the key occupations. This chapter shared some interesting perspective on the learning pathways of the four identified respondents, including the early education history, learning pathways decisions and experiences related to sustainable development and lastly the issues, interesting aspects, and complexities related to the learning pathways and rehabilitation practices. I used analysed documents to share insights into how such learning pathways are viewed from a wider system perspective. After that observation data was then able to show the real context of the rehabilitation practices, which showed how the practices influenced the learning pathways. In the next chapter I discuss core issues of the study in further detail.

CHAPTER 5

PROVISIONING FOR LEARNING PATHWAYS IN A DIFFERENTIATED SYSTEM

5.1 Introduction

From Luhmann's system theory, the principal feature of modern society is the increased process of *system differentiation* as a way of dealing with the complexity of its environment (Rasch, 2000 cited in Ritzer & Goodman, 2004). To understand learning pathways, systems and articulation issues there is a need to consider systems element which exist and system elements which may not be there. In this research two issues seems to be critical for learning pathways; namely, an understanding of how learning pathways emerge in the context occupations and the provisioning of education and training. These are discussed in this chapter.

5.2 Learning pathways and how they emerge in a differentiated system from the career stories

In South Africa it is possible in a range of occupations, within a differentiated system, to follow a structured learning pathway involving Umalusi to CHE and In-service training/or QCTO (workplace). Using this framework it is possible to investigate learning pathways of the key occupations outlined in Chapter 4 to establish whether these accredited training programmes prepared them for understanding rehabilitation practices in the mining industry. This will also provide an understanding of whether workers being employed in the mining industry are being offered training on these issues or whether FET college systems and/or university education make provision for such training.

As discussed in Chapter 2, the National Qualifications Framework aims to ensure progression and portability of all qualifications from entry level 1 to level 10 as outlined in the Table 2.1. I reflect on all the four occupations studied through the respondents' career stories, to see the scope of such progression from the perspective of learning pathways for rehabilitation practices.

Table 5.1 Career progression

(Umalusi)	CHE	QCTO
X – Matric	X - Bachelor degree	X – mine manager related courses

5.2.1 Mine manager career story

As shown in Table 5.1 the mine manager completed training accredited by three subsystems of the NQF namely; Umalusi, the CHE and QCTO system which are to provide training which is occupationally directed at workplace.

Table 5.2 Career progression

(Umalusi)	CHE	QCTO
X – Matric X – N4	X – Mining Engineering at UNISA X – Human Resource Management	X – SAMTRAC X – COSMOC 1&2

5.2.2 Safety officer career story

As shown in Table 5.2, the safety officer completed schooling and FET college sub-framework (Umalusi) and two higher education sub-framework (CHE). Two QCTO subsystems were provided to the participant.

Table 5.3 Career progression

(Umalusi)	CHE	QCTO
X – Matric	X – BA Psychology X – Diploma in mining impacts and mining rehabilitation	

5.2.3 Rehabilitation Practitioner

Table 5.3 shows that the rehabilitation practitioner's learning pathways and articulation issues are conceptualised differently, and depended on the decisions he made through formal learning opportunities. He completed accredited training provided in the formal schooling (Umalusi) subsystem, and CHE programme subsystem, which involved a switch from Psychology to Sciences and inter-disciplinary studies.

Table 5.4 Career Progression

(Umalusi)	CHE	QCTO
X – Matric	X – BSc X – Center for Invasion Biology X – Biodiversity Academic Internship	X – Wilderness School

5.2.4 Botanist

Table 5.4 shows that the Botanist completed Umalusi, CHE and QCTO. Articulation in this case resides at the interface between formal Umalusi and CHE accredited education and training programmes. In this case short courses were not accredited by the QCTO framework, informal education and training experiences were acquired while studying at personal expense, and included work-based experience and short courses training offered

by the CHE system including short courses focusing on environmental impact assessment and conservation which provided for rehabilitation training (practices).

5.3 Availability of education and training

An interest in education and training provisioning has been at the core of this study in the context of learning pathways. At one level it has already been argued that education and training can promote sustainable practices and improve capacity of key occupations to address the environment and sustainability issues such as rehabilitation. In particular, and according to the QCTO subsystem, training should have an occupationally directed or on the job-specific focus and should be aimed at filling gaps in knowledge and skills that would help individuals to find employment or perform better in the workplace and through this become more involved in environmental and development practices of relevance to their occupation (MQA, NSDS III).

The NQF as a whole should provide all organised systematic education and training activities in which people take part in order to obtain knowledge and/or gain new skills for a current or future job, to increase earning, to improve jobs and/ or career opportunities in a current or another field and generally to improve their opportunities for advancement and promotion.

As seen from the data presented in Chapter 4, such education and training can inform the learning of rehabilitation practices, and that this can be done either through relevant courses (as in the case of rehabilitation practitioner, the safety officer and the botanist)or through experiential 'learning on the job' as in the case of the mine manager. Accredited and institutionalised on the job training is important in this regard, as shown by the importance of induction training. However, as shown by the learning pathways maps above, it would seem that the QCTO system could provide for more formalised training programmes for rehabilitation programmes in the workplace. These findings are discussed in more detail below through the use of analytical statements.

5.3.1 My analytical statements

In Chapter 4 there is evidence that indicates the following:

Analytical Statement 1:

> The mining industry seemed to be active in practising safety-based induction training as entry level training for every occupation and after that there is no QCTO-based accredited training being offered within the industry itself (certificate of competence) for rehabilitation practices.

In Chapter 4 it was noted that education and training programmes in the mining industry are needed to ensure competence in the environmental sector (DEA, 2010). Generally this is the training provided to new employees by the employer in order to assist in adjustment to their new job tasks and to help them become familiar with their new work environment and the people working around them. This sort of training is of a general occupational nature, it covers everything, and hence it is not occupationally directed for specific environmental functions and roles such as rehabilitation. For example, the same training offered to an excavator operator, is also the same training which is being offered to an environmentalist. Insights obtained from the induction course material, as well as in interviews especially with the *mine manger*, that no person will work on the project, or enter or be allowed to remain on the premises unless they have received and acknowledged in writing that they have received, understood and accepted the conditions detailed in the induction programme. This provides an important opportunity for some general aspects of rehabilitation practice training but may not be fully adequate.

Appendix 5 gives an overview of this introductory training/initiation. The training does require that employees recall or recognise what has been learned. However, as shown in Chapter 2, rehabilitation is complex and differs in different rehabilitation contexts and the scale of destruction is changing/or increasing every day. Different occupations also have different responsibility for the practice, and require different learning opportunities. As shown in this study, employees change responsibilities and learning pathways, but still offered one particular type of induction training. As noted in Chapter 2, the Chamber of Mines (2011) challenges the mining industry to continue to engage with improving

education and training and Sternberg (2000) extends this argument stating that employers consider this training in their assessment of competence. Given this situation, and the scope and complexity of the rehabilitation practices, as shown in Table 2.2 and Table 2.3, it is possible to suggest that more specialised accredited training for rehabilitation practices should be on offer.

In the borrow pits case study, the company does offer induction training programmes to the stakeholders which includes *"Occupational Health and Safety Induction, Environmental awareness and training, and social facilitation"* (Botanist career story). In the case study of the coal mine it is a must for everybody to do basic induction training and this is done by all occupations. In both cases, no specific rehabilitation practice training was on offer as a formal workplace learning opportunity.

Induction training therefore seems to be the main way of supporting change oriented workplace learning and sustainability practices in the mining industry. Perhaps the main issue which emerges from the data is that induction training programmes require a lot of information to be imparted. Many people do induction for formality (for the sake of doing it) and even forget about it. As there are many possible learning pathways taken to any employment destination as the career stories outlined in Chapter 4 show, depending on the specialised competence, the learning pathways will be unique. Induction training may therefore not provide adequately for the unique learning pathways and roles in rehabilitation practice.

One of my research questions focused on **specialised competence** (combination of knowledge, skills, values and work experience) for rehabilitation practice (see Table 2.2 and Table 2.3 & section 5.1 to section 5.4). From this it is possible to see that this type of training, induction training, is narrowed at workplace level and focuses on all health and safety guidelines. In line with the research question and from the above discussion it is possible to conclude that induction training is only one small aspect of the education and training opportunities needed for the **specialised** occupational demands of rehabilitation. Gaining access to and also making use of it can be seen as an 'ice-breaker'.

Described in Chapter 2, I now look at the policy context to show how SAQA's attempts at developing specialised competence (Kraak, 2004) and also articulation issues associated

with rehabilitation practices education and training related to new legislation and compliance can be further developed (Lotz-Sisitka, 2012).

Analytical statement 2:

Policies influence education and training in the mining industry, but these need to make specific provisioning for new areas of specialised competence such as rehabilitation practice.

The policy context influences education and training in the mining industry. MQA has been established to translate and implement education and training policy for the mining industry. The policy documents explicitly show that education and training should articulate with the environmental sector and that SAQA should provide guidance on how the industry can integrate new knowledge and skills through relevant Sector Skills Planning (as discussed in section 4.3.1.). Policies also suggest that workplace learning should provide quality education and training as recognised by the NQF as discussed in Chapter 4. The policies proved to have an influence on the Mining Qualification Authority (MQA) which is a registered Sector Education and Training Authority (SETA) with responsibility for generating and registering unit standards and qualifications and to maintain quality as well as to give effect to the requirement in terms of the Skills Development Act of 1998. The MQA supports the following environmental training, as reflected in section 4.3.2 which includes intermediate environmental control, mine environmental control and environmental conservation and rehabilitation as was emphasized in Chapters 2 and 4.

From this it can be seen that policies require education and training to be offered but there seems to be detachment between what policy offers and what I observed and the main findings emerging from Chapter 4. As indicated by the policy document, which states *"proposals for the education and training standards and qualifications in the mining industry on the national qualification framework (NQF) referred to in the SAQA, 1995 (Act No.58 of 1995) and 5.2 of the SAQA Act determines the objectives of the NQF and the MQA promotes the objectives of the NQF in the mining industry"* (D12, pp. 3-4). The Training manual for education and training for the mining industry (APCOR) indicated that "*the employer must*

keep a record of all formal training provided in respect of each employee in terms of sub section(2). All mines must submit a workplace skills plan and the annual training reports to the mining qualification authority [Sub-s. (5) Added by s.3 of Act No. 74 of 2008.]" (D11, pp. 4-5).

Policies are in place but there appears to be little engagement with rehabilitation training. The NQF Act No.67 of 2008 seeks to *"accelerate the redress of past unfair discrimination in education training and employment opportunities, and also to enhance the quality of education and training"* (D4, pp. 3-4). This does not extend to rehabilitation training, as indicated by one of the key occupations when asked if he had attended any in service training on rehabilitation said "*Nothing, I didn't go for training"* (Rehabilitation practitioner). This shows that it is not always a simple matter to implement a policy and greater attention may need to be given to new contextual demands, and the role of employers in implementing those policies, and also in planning for training interventions that meet new, complex practice demands, such as rehabilitation training.

 Seen from the broader perspective this can be traced to wider system issues. The Deputy President of South Africa stated that *"the skills development problems in our country could be attributed to the weakness in the education and training system, starting from early childhood development and continuing right through the school and post-school system and on-going workplace professional development"* (D2, p. 1). Low or inadequate skills development in South Africa can be attributed to weak education and training, hence the need to give attention to such issues in research, as shown by this study.

Recently there has been a drive from the environmental sector to address such issues (DEA, 2010; HSRC, 2009). A national Environmental Sector Skills Plan (DEA, 2010) seeks to "*describe the current status quo with regard to demand and supply of environmental skills, and provides the best available information on scarce skills and critical skills in the sector at present from a supply and demand perspective"* (D6, p. 1). However, these efforts need to be customised at a sector, including through the MQA. The way and manner (context) in which these policies are situated through workplace learning also appears to require improvement. The ESSP states that there is need to *"further provide guidance on improving environmental sector skills development planning and implementation within the national*

education, training and skills development system" (D6, p. 3). From this analysis it is possible to see that the education and training programmes needed for rehabilitation could find support in existing structures and policies and through the national government systems. However, such training currently lacks workplace mentorship and this has an impact on current and future career/or learning pathways to improve rehabilitation practices.

Analytical Statement 3:

Provisioning of education and training based on the Organising Framework for Occupations (OFO) categories in the Quality Council for Trades Occupations (QCTO) requires development if rehabilitation practices training is to be offered within this sub-framework in mining workplaces.

As reported in Section 2.4 workplace learning is to be provided for by the QCTO subsystem as one of the three Quality Councils (QCs) in South Africa. Section 5.2 above showed that learning pathways are influenced by various quality management authorities especially Umalusi and CHE. To expand such articulation possibilities to include a stronger role for the QCTO system, especially for rehabilitation practice training, will require stronger links between the environmental sector and the education and training subsystems in a differentiated system.

Luhmann's (1990) work explains that for systems to respond to the changes in the environment, and to understand such changes there is need for attending to system factors enabling/or constraining learning pathways of key occupations that are needed to respond to rehabilitation practice issues in the wider environment.

As mentioned in the previous Chapters 2 and 4, the QCTO's function is to oversee occupational qualifications development involving workplace training to ensure relevant, high accredited training offered by reputable service providers and report on this to the Department of Higher Education and Training. To structure this reporting, and to structure QCTO programmes, the OFO system is used for decision making as to what counts as relevant occupational description and therefore what occupational training is needed. This research established that a number of key occupations relevant to rehabilitation practices

are represented within the OFO (see Appendix 2). However, most of the occupation descriptions lack refinement when it comes to showing their responsibility for rehabilitation practices.

In Chapter 4 a number of challenges related to obtaining relevant rehabilitation training were identified amongst the key occupations with regard to 'workplace training' or short courses provided by the QCTO system, as shown in sections 5.2.1 to 5.2.4 where the QCTO category is void and only the Umalusi and CHE systems are providing accredited training of relevance to rehabilitation practice. Revision of the OFO descriptors and engagement with the QCTO on these issues may therefore be needed.

In Chapter 2 McCarthy and Pretorius (2009) noted that "mining in South Africa is closely linked with the economic development of the country" (p. 56). The QCTO seeks to ensure well developed occupational qualifications that are market driven and offered by accredited providers. Chapter 4 data shows that all occupations reviewed are not receiving such training from the QCTO systems for rehabilitation practice. This reflects uncertainty and struggle with career pathing within their occupation, and may be linked to a lack of recognition of importance of rehabilitation training by industry and employers, and inadequate engagement between the environmental sector and the QCTO structures.

Part-time qualifications like short courses are critically needed in SA, when the rehabilitation practitioner was asked if he had attended any short courses he said *"No short courses"* instead he attended the "*International Association of Impact Assessment (IAIA meetings), but I'm currently studying towards my honours qualification"*. No one is paying for his occupational qualification, which again shows that opportunities are not available in the system. The safety officer was also studying while at work but paying for himself.

The QCTO's development of new occupational qualifications shows to be a good idea but key occupations or companies seemed appear to not be sending their employees for skills development and training, and such training appears to need development within the QCTO system. This affects the skills revolution and the efficacy of rehabilitation practices in the mining industry. This may also be related to funds and time needed for trained, hence, companies may be reluctant to release their employees, and prefer experiential training approaches, as favoured by the mine manager.

5.4 System and Environment

As indicated above, this research focuses on *learning pathways.* Learning pathways are ways of navigating learning, skill development and life experiences through a mix of education and training, community experiences, workplace mentoring and experience, and personal life. There are many learning pathways taken to any employment destination and depending on the knowledge, skills and values, work and life experiences (competences) the learning pathway will be unique (see section 4.2.1 career stories). It is evident, as shown in Chapter 4 that learning pathways consist of formal qualification acquisition through school and/or tertiary education; employment-based training, volunteering, entry-level work, further study, mentorship and/or job advancement (Commonwealth, 2011) i.e. a mix of programmes governed by the Umalusi, CHE and QCTO subsystems. In this research it was found that a mix of experiences and opportunities make up learning pathways that are relevant to improved rehabilitation practices. The research also found that the currently available "mix of opportunities" can be improved, especially through further workplace learning options for rehabilitation with the QCTO subsystem.

Work and career are no longer static and predetermined entities. On the other hand knowledge is not necessarily individualised. Learning is generally understood as resulting in a permanent capacity change in people to choose or follow a career path (Illeris, 2003). The way an entire organisation or industry learns can be instrumental in its innovation and profitability and through understanding an individual's learning pathways in workplace environments, both the individual and the workplace elements of learning can be understood as shown by the analysis of rehabilitation practices and associated learning pathways in this study. If learning pathways and workplace learning are not contextualised in this way, a narrow view of learning pathways can exist that is focussed more on preparing people with the technical skills and competencies that are not appropriately situated (Cullen et al., 2002). This would run counter to much of the point of workplace learning as something more simple than training with a narrow focus on surface-level skills (Matthews, 1999; Winch & Ingram, 2002). Workplace learning has a broader project and potential to link development of the individual with development of the organisation or industries, through an emphasis on sustained development and learning pathways processes as well as learning outcomes (ibid). I have tried to show this relation between individual career story,

environment and related demands for new practices and the skills development system in this study.

Through analysis of career stories, workplace documents and policies of learning pathways as indicated above (previous chapters) in more depth, I drew on *systems theory* to provide such a perspective as discussed in section 2.4*.* Systems theory was proposed in the 1940's by biologist Ludwig von Bertalanffy. Von Bertalanffy described system theory as "the transdisciplinary study of the abstract organization of phenomena, independent of their substance, type, or spatial or temporal scale of existence" (Baecker, 2001, pp. 59-74). Systems theory "investigates the principles common to all complex entities, and models which can be used to describe them" (Baecker, 2001, p. 180).

Rasch (2000, p. 230) explains that from the viewpoint of Luhmann's system theory, "the principal feature of modern society is the increased process of system differentiation as a way of dealing with the complexity of the environment". He goes on to state that "Differentiation is the replication, within a system, of the difference between a system and its environment and this might mean that, there are two kinds of environments". For example, in the mining industry a company such as Coal of Africa, sees other companies, such as Anglo Coal and Witwatersrand Gold Fields, for instance, as part of its environment, even though they are differentiated. This creates a highly complex and dynamic environment. I have shown that this is the case when dealing with rehabilitation practices training in the contexts of two different types of mining (open cast coal mining and borrow pits). Similarly SAQA sees all the sub-frameworks of the NQF as part of its system, yet they are differentiated. As shown in this study, all parts of this system have important, yet differentiated roles to play in providing for rehabilitation practice training and associated learning pathways.

Ritzer and Goodman (2004, p. 191) state that:

> Differentiation within a system is a way of dealing with changes in the environment, as seen; each system must maintain its boundary in relation to the environment. Otherwise it would be overwhelmed by the complexity of its environment, breakdown and cease to exist. In order to survive the system must able to deal with environmental variation.

This study found what the differentiated system elements are of learning pathways relevant to rehabilitation practices, and how differentiation of learning pathway elements are related to changes in the environment, more specifically the need to adapt to and learn new knowledge, skills and practices for improving rehabilitation. Those differentiated systems provided lenses to see the scope of environmental variation within the system itself (which may include variation of individual biographies and diverse rehabilitation practice responsibilities as noted above) by focussing on two different rehabilitation practices, and the learning pathways of four key occupational employees within each of these cases. The learning pathways analysis also showed how the differentiated subsystem of the NQF could be working better together to facilitate learning pathways for rehabilitation practices, but with maintaining focus on specific sub-roles (e.g. QCTO's responsibly for providing relevant accredited training in the workplace for specialisation towards rehabilitation practices as per occupational requirements.

Although Luhmann's system theory has been criticised for being functionalist, it has been helpful for understanding distinctions between system and its environment and analysing the system responsiveness to the demand for sustainability and rehabilitation practices. It has also helped to see that the system develops relationally with inter-related subsystems and that this can help to simplify the complexity of the environment. In this study, the rational subsystems (Umalusi, CHE and QCTO) with their inter-related roles with the NQF were identified as all being necessary for the construction of relevant learning pathways for rehabilitation of mines. Each has roles and functions and there are the boundaries between them. The relationship among the subsystems, is however very important for such learning pathways.

5.5 Conclusion

This chapter has critically analysed and discussed the findings of the study as these relate to the career stories/ learning pathways of the respondents in key occupations, and to the education and training system and its responsiveness to the environment in the context of rehabilitation practices in the mining industry. It has provided a systems perspective on the issue, and has addressed the research questions.

CHAPTER 6

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This is the concluding chapter of the thesis. This study forms part of the research programme examining availability, adequacy and articulation issues associated with key environmental occupations focussing specifically on learning pathways in the mining industry; with specific reference to learning pathways with key occupations involved in two rehabilitation practices. This research aims to deepen the understanding of educational responses to contemporary risk and vulnerability in South Africa, particularly in the mining sector.

6.2 Summary of main findings and conclusions:

As indicated in Chapter 1, the study was guided by research question and aims. This section will summarise the main findings that emerged from the study, as presented in more detail in Chapters 4 and 5, and position them within the current debate. The Department of Higher Education and training (DHET, 2011) indicated that *access* to learning opportunities is an important and a necessary measure for understanding learning pathways. The Association for Development of Education in Africa (ADEA, 2010) also states that *articulation* is an important and necessary measure for understanding learning pathways. The DHET (2011) particularly emphasises articulation between workplace and training programme context. In summary, this found that:

1. Diverse learning pathways in different occupations can enable the development of competence (knowledge, skills and values) in relation to specific rehabilitation practices, and these rehabilitation practices require specialised knowledge, skills and practices that can be learned through a mix of course and workplace experience.

2. Support systems influencing (enabling or constraining) rehabilitation practices learning pathways are not systematically structured to meet this directly and the demand for specialised knowledge, skills and competence.

3. Access and articulation issues (how people in key occupations gain access to learning pathways relevant to rehabilitation practices in the mining industry; and what articulation exists for this learning to take place across the sub-frameworks of the NQF) is not adequately integrated into the national system of skills provisioning, especially within the QCTO subsystem and is mostly relegated to induction training or experiential 'on the job' training where relevant mentorship is available.

As reported in Chapter 2 Lotz-Sisitka and Ramsurup (2012) found that at macro level (mining industry) the NQF lacks adequate structures to deal with new emerging fields of knowledge and practice such as environment and sustainability, particularly when related to public goods issues. This is reflected in the findings of this study as key system elements such as OFO descriptors, and Sector Skills Planning were not making full provision for the practices associated with rehabilitation. Access emerged as a major constraint for occupations relevant to rehabilitation practices to improve their specialised competence, since they were not being sent for short courses focussed on such practices. Chapters 4 and 5 point out that occupation for rehabilitation practice is not easy to access in the present context. This affects wider sustainable development of society, as can be seen by reportage of the issues associated with Acid Mine Drainage in South Africa, which are related to inadequate rehabilitation practices (Chamber of Mines, 2011).

This study showed too that little is known about how people come to learn to implement and improve rehabilitation practices in the mining industry, especially in South Africa where these practices are relatively new, and knowledge of learning pathways is still unclear. This study showed that there are multiple routes that can be followed to such learning pathways and that education and training provisioning is important to these routes. To make matters more complex, the study showed that different rehabilitation practices require different knowledge, skills, values and types of work experience; and different occupational levels have different responsibilities with regards to implementation of rehabilitation practices.

Researching learning pathways for improving rehabilitation practices in the mining industry helps me to broaden the social domain from investigating human action in relation to certain natural resource or environmental issues (Folke et al., 2010), in contrast with my research study which has focussed on education and training, employment based training and the mix of experiences and opportunities that make up learning pathways that are relevant to improved rehabilitation practice.

The study showed too that greater understanding of these issues are required if high quality, relevant training is to be provided at a systems level. Understanding learning pathways to rehabilitation practices can help to further this understanding as shown by this study. However, as this study was only a small scale study, further research may be needed to broaden the findings in this study.

6.3 Recommendations

Accordingly, this research as a whole highlighted the need for greater attention to be paid to education and training for improving rehabilitation practices in the context of workplace learning. Through this study of learning pathways, Chapters 4 and 5 brought up some interesting findings that might require further research which include amoung others:

1. The significance of occupational education and training systems in the mining industry and all their potential to strengthen rehabilitation practices.
2. The influence of education and training programmes in a differentiated system with emphasis on workplace learning for rehabilitation practices in the mining industry.
3. The need to understand learning pathways in the NQF more broadly (only four learning pathways related to four occupations were explored in this study due to its limited scope).
4. The role of the different Quality Councils in enabling sustainable development learning pathways especially in the mining industry.
5. As this research was focussed on one sustainable development practice only (namely, rehabilitation practice) in only two types of mining (open cast and borrow pits) it could potentially be expanded to other types of sustainable development

practices in the mining industry, e.g. mine reclamation and management of Acid Mine Drainage or to more types of mining, and also include more detailed analysis of skills development for specialised competency required throughout the various stages of the rehabilitation process.

The study shows how workplace learning can be developed in the South African context also in the context of work and learning in the environmental sector and mining sector. This study also provides insight into how an occupational focus can shed light on construction in learning pathways for rehabilitation practices. It also shows some of the education and training needed in the mining industries to improve sustainable development practices. Therefore, I recommend that the South African Qualifications Authority and Rhodes University abstract some of the work from the study to inform the future direction of education and training in workplaces. This study was funded under this programme and there is potential to consider the study findings and processes to inform recommendations at a broader level.

REFERENCES

ADEA. (2010). Regional seminar on post-primary vocational and training, Ile de La reunion, 26-27 May 2010*. The right to education and decent work: implementing post-primary vocational and training policies for a skills society*.

ASPASA. (2009). Aggregate & Sand Producers Association of Southern Africa: *The Issue of Borrow Pit Being Used in the Aggregate and Sand Industry.* Gauteng, South Africa

Baecker, P. (2001). *Why system theory, culture and society* 18, 59-74.

Bassey, M. (1999). Case Study Research in Educational Settings. *Journal of Education for Teaching. 26*(1).

Benbasat, I., Goldstein, D.K., & Mead, M. (1987). The case research strategy in Studies of Information Systems. *MIS Quarterly 11*(3).

Bengu, S.M.E. (1995). *Education and Training in a Democratic South Africa: first step to develop a New System*. Pretoria: Department Education.

Beukes, W. (2008). *Generic guidelines for rehabilitation of borrow pits on linear pipeline projects,* Department of Geography, Environmental Management and Energy Studies. Institutional Repository & Scholarly Communication, University of Johannesburg.

Bhaskar, R. (1997*) A realist theory of science* (2nd ed.). London: Routledge.

Bisschoff, T., Govender, C., & Oosthuizen, P. (2004). *Project Management in Education and Training.* Van Schaik Publishers.

BMMR. (2009). Bureau of Mining and Mineral Regulation: *Guidance for Evaluating Borrow Pit Activities.* North West Florida. Chapter 62-346, F.A.C. Applicant's Handbook Volume I.

Bowen, G.A. (2009). Supporting a Grounded Theory with an Audit Trail: an illustration. *International Journal of Social Research Methodology*. 305-316.

Brynard, P.A., & Hanekom, S.X. (2006). *Introduction to research in management related fields* (2nd Ed.). Van Schaik publishers.

Candy, P., Grebert, R.G., & O'Leary, S. (1994). *Developing lifelong learners through Undergraduate Education.* Canberra: Australian Government Publishing Service.

Chamber of Mines of South Africa. (2007). *Skills development*: *Human Resources Development*, South Africa.

Chamber of Mines. (2011). *Skills development Unit.* South Africa.

Christie, P. (1996). Globalisation and the Curriculum: Proposal for the integration of education and training in South Africa. *International Education Journal of Educational Development*, *16* (4), 407-416.

CoalTech. (2007). *Coaltech Research Association Annual Report*. South Africa.

Cohen, L., & Mallon, M. (2001). My Brilliant Career? Using Stories as a Methodological Tool in Career Research. *International Studies of Management & Organisation*, *31*(3), 48-68.

Commonwealth. (2011). *Australian Government, Department of Education, Employment and workplace Relations.*

Cooper, D.R., & Emory, W. (1995:21). *Research methods*, University of Pretoria, Book, Illustrated.

Cropley, A. J., & Knapper, C. K. (1983). Higher education and the promotion of lifelong learning. *Studies in Higher Education*, *8*, 15-21

Csech, M. (2003). Facilitating learning in multicultural teams: *Advances in Developing Human Resources, 5*(1), 26-40.

CSIR. (1992). Council for Scientific and Industrial Research*, Hazardous waste in South Africa,* Pretoria, 15.

Cullen, J., Hadjivassiliou, K., Hamilton, E., Kelleher, J., Sommerlad, E., & Stern, E. (2002). *Review of current pedagogic research and practice in the fields of post-compulsory education and lifelong learning* (final report submitted to the Economic and Social Research Council). London: The Tavistock Institute.

Daniels, R.C. (2007). *Skills Shortages in South Africa: Development Policy Research Unit,* DPRU working paper 07/121.

DEA. (2010). Environmental Sector Skills Plan for South Africa. *A system approach to human capacity development and sector skills planning*. Department of Environmental Affairs, Government printers.

De Korte, G.J. (2010). Coal preparation research in South Africa, *journal paper, 110.*

Department of Labour. (2005). National Skills Development Strategy: *The strategy outlines the strategic objectives and success indicators for skills development*. Pretoria, Directorate of Communication.

Department of Minerals and Energy. (1998). *A minerals and Mining Policy for South Africa*: *Green Paper for public discussion*, Pretoria, South Africa.

DHET. (2011). Framework for the National Skills development Strategy III. First Draft for Consultation 2011/12 – 2015/16. Department of Higher Education and Training.

DoL and DoE. (2003). Department of Labour and Education: *Report of the study team.* Implementation of the National Qualifications Framework. Pretoria.

DoL and DoE. (2007). *Enhancing the efficacy and efficiency of the National Qualification Framework.* Pretoria, Joint policy statement by the Ministers of Education and Labour.

DYNA Training. (2005). *South African Leadership Trends*. Johannesburg, Full Report Released in October 2005, DYNA Training.

Edmeston, M. (2010). *Risk in a divided society: The Case of Acid Mine Drainage on the West Rand, South Africa, as an Example of a Risk Society*. Unpublished master's thesis, University of the Witwatersrand, Johannesburg.

Edwards, R., Raggatt, P., Harrison, R., McCollum, A. & Calder, J., (1998). *Recent Thinking in Lifelong Learning*. A review of the literature: The Open University, London, DFEE.

Ensor, P. (2003). The National Qualifications Framework and Higher Education in South Africa: some epistemological issues. *Journal of Education and Work*, *16* (3), 325-346.

ESAE. (n.d). European Society of Association Executives: What *is lifelong learning?* The view from the European Commission. London, 1 Queens Anne's Gate.

Europa. (2003). European Commission: Policy Areas: Lifelong Learning, *What is Lifelong.* //europa.eu.int/comm/education/policies/lll/life/what_islll_en.html.

Folke, C., Carpenter, S.R., Walker, B., Schiffer, M., Chapin, T. & Rockstrom, J. (2010). *Resilience Thinking: Integrating Resilience, Adaptability and Transformability. Ecology and Society* 15(4): 20.

Food & Beverage SETA. (2005). *Sector skills plan:* 2005-2010, Draft Document: October 2005, Food & Beverage SETA, Pretoria.

Frost & Sullivan Mining Industry Analyst. (2009). *A strategic analysis of South Africa's coal mining industry*, 113 pages – SKU: MC2481420.

Galliers, R.D. (1991). *Information systems Research*: *Contemporary Approaches and Emergent traditions. Choosing Appropriate Information Systems Research Approaches: A Revised Taxanomy.* North Holland. 327-345.

Gardner, J. (2001). *Rehabilitating mines to meet land use objectives: Baurite mining in the jarrah forest of Western Australia.* An international journal of forestry and forest industries - Vol. 52 2001/4.

GDACE. (2008). Gauteng Department of Agriculture, Conservation and Environment: *Mining and Environmental Guide*. Produced by staff of Digby Wells and associates, Growth Lab and the Council for Geosciences.

Gilbert, M. (2000). Mine-site Rehabilitation, Department of Mines and Energy, Mareeba, Queensland, Australia, *34,* 147-154.

Gross, C.G., Rocha-Miranda, C.E., & Bender, D.B. (1971). *Visual Properties of Neurons in Inferotemporal cortex.* 35(1): 96-111.

Gunderson, L.H., & Holling, C.S. (2002). *Panarchy*: *Understanding transformations in human and natural systems*. Washington DC: Island Press.

Hancock, G.R. (2004). The use of landscape evolution models in mining rehabilitation design: *Environmental Geology, School of Environmental and Life sciences, Australia.*

Harrell, M.C., & Bradley, M.A. (2009). *Data collection methods: Training manual, National Defence Research Institute.* Prepared for the US Government, Rand Co-operation.

Harris, R., Rainey, L., & Summer, R. **(2005).** *Student traffic: Two way movement between vocational education and training and higher education*. National Centre for Vocational Education Research, Adelaide.

Harris, R., Rainey, L. & Sumner, R. (2006). Crazy paving or stepping stones? *Learning pathways within and between VET and higher education*, NCVER, Adelaide.

Henning, E., Van Rensburg, W., & Smit, B. (2004). *Finding your way in Qualitative Research.* Pretoria: Van Schaik Publishers.

Hoadley, E.M., Limpitlaw, D., & Weaver, A. (2002). Mining, Minerals and Sustainable Development in southern Africa, MMSD southern Africa, Johannesburg, South Africa, *1*, 77.

Horwitz, F. & Bowmaker-Falconer, A. (2003). Human resources development review 2003: *Education, employment and skills in South Africa*, HSRC Press, Cape Town.

Human Resource Development Strategy. (2001). *A nation at work for a better life*. Asmal, K. (2001, February 13). Opening of Parliament media address by the minister of education, Cape Town, South Africa. Retrieved August 15, 2003, from **http://www.gov.za/speeches/hrd.pdf**

Human Resource Development Strategy. (2004). *Towards a Multi-Level skills Strategy in the Western Cape*. Written by Glenda Kruss, HSRC Press.

HRSC. (2003). Human resources development review: *education, employment and skills in South Africa.* Cape Town: HSRC Press.

HSRC. (2009). Guidelines for a human capital development strategy in the biodiversity conservation sector. Research report produced for the Lewis Foundation and the SA National Biodiversity Institute (SANBI).

IAIAc (2003). INTERNATIONAL ASSOCIATION FOR IMPACT ASSESSMENT: *Biodiversity in Impact Assessment.* [online]. Available: Http://www.iaia.org/modx /assets/files/SP3.pdf (accessed 08/08/2007).

Illeris, K. (**2003**). Workplace learning and learning theory. *Journal on workplace learning*, *15(4*), 167– 178.

ILO. (2007). Improving Workplace Learning in Asia and the Pacific: *Report of ILO/SKILLS-AP/KRIVET.* Seoul, the Republic of Korea, 15-17 May 2007.

IMC. (2010). Inter-Ministerial Committee on Acid Mine Drainage*: Mine Water Management in the Witwatersrand Goldfields with special emphasis on AMD*. Co-ordination of the Council for Geosciences.

Jeris, L., & Johnson, K. (2004). Speaking of Competence: *Toward a Cross-translation for Human Resource Development (HRD) and Continuing Professional Education (CPE),Academy of Human Resource Development Annual Conference*, Austin, TX, 4-7 March, Proceedings Vol.2, 1103-1110.

Kraak, A. (2004). *An overview of South African human resources development*. Cape Town: HSRC press.

Kraak, A. (2009). *Sectors and Skills:* the need for policy alignment. Published Cape Town 2009.

Lawrence, D.C. (2001). Mine closure and the community. *Mining Environmental Management,* 9(4): 10-12.

Limpitlaw, D., Aken, M., Lodewijks, H., & Viljoen, J. (2005). *Centre for sustainability in mining and industry; Anglo coal and bhp Billiton.*

Limpitlaw, D., Aken, M., Lodewijks, H., & Viljoen, J. **(2005).** South African Institute of Mining and Metallurgy: *Post-Mining Rehabilitation, Land use and Pollution at Collieries in South Africa.* Centre for Sustainability in Mining and Industry.

Litman, T. (2012). Evaluating Research Quality. *Guidelines for Scholarship (EFFICIENCY-EQUITY-CLARITY)*. Victoria Transport Policy Institute, 250-360-1560.

Lotz-Sisitka, H. (2004). Environmental Education Research and Social Change: Southern African Perspectives Special Issue: *Environmental Education Research Journal*, *10*(3), 291-442.

Lotz-Sisitka, H. (2008). Environmental education and educational quality and relevance: Opening the debate. *Southern African Journal of Environmental Education* 25: 5-11

Lotz-Sisitka, H. (2010). *Change oriented workplace learning & sustainable development practices: Research Programme Proposal.* Grahamstown: Rhodes University Environmental Education & Sustainability Unit,

Lotz-Sisitka, H. (2012). *Change oriented learning and sustainable development.* South African Qualifications Authority-Rhodes University (SAQA-Rhodes) Partnership Research.

Lotz-Sisitka, H., & Olvitt, L. (2009). South Africa: Strengthening Responses to Sustainable Development Policy and Legislation. *Technical and Vocational Education and Training Series.* Chapter 23 on: Work, Learning and Sustainable Development.

Lotz-Sisitka, H., & Ramsurup, P. (2012a). *Absenting in Learning Pathways*: *A methodological exploration.* Rhodes University, Grahamstown.

Lotz-Sisitka, H., & Ramsurup, P. (2012b). *Learning Pathways, Articulation and Differentiation: Early conceptual exploration and implications for research design/s.* Unpublished material, Rhodes University, Grahamstown.

Lotz-Sisitka, H., Motsa, E., Mukute, M., & Olvitt, L. (2008). *Theory matters: Developing a conceptual framework for researching change-oriented workplace learning and sustainability practices to inform standard setting.* Unpublished, Rhodes University, Grahamstown.

Llywodraeth Government. (2011). *Learning Pathways 14-19 is the distinct approach being taken in Wales to transform the way in which young people are educated.* National Assembly of Wales, Scottish Government, Northern Ireland Executive, GOV.UK.

Luhmann, N. (1984). *Social Systems: Outline of a General Theory*. Stanford University Press.

Luhmann, N. (1990). *Die Wissenschaft der Gesellschaft*. Frankfurt am Main: Suhrkamp.

Lumby, A. (2005). Government and sustainable in South Africa: The environmental legislative framework in historical context. *South African Journal of Economic History*.

Maree, J. Lundall, P., & Godfrey, S. (2008). *Industrial structure and skills in the metals beneficiation sector of South Africa.* Research report prepared for the Department of Labour in association with the Human Science Research Council.

Mathison, S. (1988). Why triangulate. *Educational Researcher*, *17*(2), 13-17.

Matthews, P. (1999). Workplace learning: Developing a holistic model. *The Learning Organization*, *6*(1), 18–29.

Maxwell, J. A. (1992). Understanding and validity in qualitative research. *Harvard Educational Review. 62*(3), 279-300.

McCarthy, T.S., & Pretorius, K. (2009). *Coal mining on the Highveld and its implications for future water quality in the Vaal River System.* Abstract of the international mine water conference, 19[th-] 23th October 2009, Pretoria.

Mitchell, J.G., Henry, J., & Young, S. (2001). *A new model of work based learning for the VET sector.* Melbourne: ANTA.

Moffat, A.J. (2001). Increasing woodland in urban areas in the UK: meeting ecological and environmental standards. In *Forests in a changing landscape*. Proceedings of the 16th Commonwealth Forestry Conference, 18-25 April 2001, Fremantle.

MMSD. (2002). *Breaking New Ground*: *Mining, Minerals and Sustainable Development*. Report of the MMSD Project. London: Earth scan.

MQA. (2009a). *A Guide for Identifying and Addressing Scarce Skills and Critical Skills in Mining and Mineral Sector*. Revised version, Pretoria.

MQA. (2009b). *Revised terms of reference for the appointment of a short term consultancy to investigate, analyse and report on causes of poor results for examinations for identified certificates of competency administered by department of minerals resources (DMR) and chamber of mines (CoM).*

Mukute, M. (2010). *Exploring and expanding learning in sustainable agricultural practices in Southern Africa.* Unpublished draft PhD, Rhodes University, Grahamstown, South Africa.

Mukute, M. (2011). *Theory and practice of learning for agency and transformation*: *A manual for facilitators of learning and development in Agriculture and Natural Resource Management*, Draft 1- not for wider distribution.

Myers, M.D. (2009). *Qualitative Research in Business and Management*. London: Sage Publications.

National Skills Development Strategy. (2001). *Skills for Productive Citizenship for All*: Ministry of Labour.

O'Donoghue, R., Rosenberg, E., & Olvitt, L. (2008). *Towards Better Environmental Sustainability Practices*: *Methods and Processes to support Change-Oriented Learning.*

O'Neil, J. (1999). *'The Role of Learning Advisors in Action Learning'*, Unpublished dissertation. Teachers College, Columbia University, New York.

Panigrahi, A. B., & Murthy, A.N. (2008). *Rehabilitation and Reclamation Practices in Goan Iron Ore Mines.* Indian Bureau of mines, Annual report of ArcelloMittal.

Patton, M. (2001). *Qualitative Research and Evaluation Methods*. (3rd ed). Thousand Oaks, CA: Sage.

Patton, W., & McMahon, M. (2006). Career development and system theory: Connecting and practice (2nd ed.). Rotterdam. The Netherlands: Sage Publishers.

Ramsurup, P. (2012). *Occupational and Environmental Learning Pathways.* Unpublished draft PhD thesis, Rhodes University, Grahamstown.

Rasch, W. (2000). *Niklas Luhmann's Modernity*: *The Paradoxes of differentiation.* Stanford, Calif: Stanford University Press.

Risser, P.G. (1992). Landscape ecology approach to ecosystem rehabilitation. In: MK   Wal, (Ed). *Eco-system rehabilitation*, *1,* 37-46.

Ritzer, G. & Goodman, D.J. (2004). *Modern Sociological Theory*. Melbourne, McGraw-Hill Publisher, Sixth edition.

Rogers, P.P., Jalal, K.F., & Boyd, J.A. (2005). *An introduction to sustainable development.* Phillippines: Island Publishing House Inc.

Rolfe, J. (2000). *Mining and Biodiversity: Rehabilitating Coal Mine sites, feature article*.

RSA. (1991). Minerals Act No. 50 of 1991: *Assented to 15 May 1991.* Republic of South Africa.

RSA. (1996). *Mine Health and Safety Act No. 29 of 1996: MHS Regulations. Published under Government Notice R93 in Government Gazette 17725*, Republic of South Africa.

RSA. (1998). National Environmental Management Act No. 107 of 1998. Government Gazette, November 1998, Cape Town.

RSA. (1998). National Water Act No. 36 of 1998. Government Gazette, Cape Town.

RSA. (1998). Skills Development Act No. 97 of 1998, Republic of South Africa, *Government Gazette,* Cape Town.

RSA. (1999). The skills Development Levies Act No. 9 of 1999. Government Gazette, Cape Town.

RSA. (2002). Mining Petroleum and Resource Development Act No. 28 of 2002. Government Gazette, Cape Town.

RSA. (2008). National Qualification Act No.67 of 2008. Government Gazette, Republic of South Africa. Volume S24.

RSA. (2008). National Qualification Act 67 of 2008: *Regulations for resolving a dispute in terms of the National Qualifications Framework Act, 2008*. Government Gazette, Vol. 521, Cape Town.

Rubin, H.J., & Rubin, I.S. (1995). *Qualitative interviewing: The art of hearing data.* Thousand Oaks, CA: Sage.

Sandberg, J. (2000). *Understanding human competence at work: An interpretative approach*, Acad Manage J.

SANRAL. (2008). *Land Acquisition Guidelines for Consulting Engineers*.

SAQA. (2000). *Models for accreditation: The Recording of Short Courses*, Government Printers, Pretoria.

SAQA. (2001). *Development of Level Descriptors for the National Qualifications Framework: Document for Public Comment* (Pretoria, December 2001).

SAQA. (2002). *Criteria and Guideline for Short Courses and Skills Programme*: *Discussion Document for Public Comment*. Pretoria, 6 November 2002.

SAQA. (2002). Draft *Level Descriptors*, p. 52. See also draft *NAP*, p. 57. The Recognition of Prior Learning in the context of the National Qualifications Framework, Pretoria.

SAQA. (2003). *An Independent – NQF System*: *Consultative Document*.

SAQA. (2009). *Registered Qualification*. National Certificate: Environmental Practice.

Sauve, L. (1999). Environmental Education between modernity and post-modernity: Searching for an integrating educational framework. *Canadian Journal of Environmental Education* 4: 9-35.

Savickas, M.L. (2005). *The Theory and Practice of Career Construction.* Pp. 42-70 in Career Development and Counselling: Putting Theory and Research to Work, edited by S. D. Brown and R. W. Lent. Hoboken, NJ: John Wiley & Sons.

Schlüter, T., & Trauth, M.H. (2008). Geological Atlas of Africa: with notes on Stratigraphy, Tectonics, Economic Geology, Geohazards and Geosites and Geoscientific Education of each country. Springer, Berlin.

Schmidt, S. (2010). *Coal deposits of South Africa*: *the future of coal mining in South Africa*. Freiberg: Institute of Geology, Gustav-Zeuner-Str. 12, 09599

SHE. (2010). Shumani Safety health and Environment Specialists*: Borrow Pits Closer Report.* Submitted to the department of Transport, Limpopo Province.

Sternberg, R.J. (2005). *Intelligence, Competence, and Expertise,* edited by A.J. Elliot & C.S. Dweck (Eds.), Handbook of Competence and Motivation (pp. 15-30) New York: Guilford Press.

Stewart, D. W., & Shamdasani P. N. (1990). *Focus Groups: theory and Practice.* Thousand Oaks, California: Sage.

Swart, E. (2003). The South African legislative framework for mine closure, Proceedings of the Colloquium on Mine Closure for Sustainable Development, *South African Institute of Mining and Metallurgy,* Johannesburg.

Swart, M.M., & Tanner, P. (2007). Guidelines for the Rehabilitation of Mined Land: *Chamber of Mines of South Africa/ Coal Tech Research Association.*

Telela, P. (2004). In McGrath, S., Badroodien, A., Krrak, A, & Unwin, L. (Eds). Shifting understanding of skills in South Africa*: Overcoming the historical imprint of a low skills regime.* Department of Labour, Pretoria.

Temple, B., Edwards, R., & Alexander, C. (2006). Grasping at Context: Cross language qualitative research as secondary qualitative data analysis. Forum Qualitative Forum: Qualitative Social Research.

Toy, T.J., & Hadley, R.F. (1987) *Geomorphology of disturbed lands*. New York: Academic Press

University of Ballarat. (2003). *Learning Pathways Policy: University Policy*. Victoria, Approved by the academic board.

Vaughan, K. (2008). *Workplace Learning: a literature review.* Report for Competenz, New Zealand Council for Education Research.

Von Bertalanffy, L. (1962). General System Theory - A Critical Review. *General Systems VII*, 1-20.

Viljoen, M.J., & Reimold, W.U. (1999). *An introduction to South Africa's geological and mining heritage.* Mintek, Randburg.

Walker, R.G. (1993). Finding a Silent Voice for the Researcher. Using Photographs in Evaluation and Research, in M.Scratz (ed.) *Qualitative Voices in Qualitative Research*. London: Falmer Press.

Walters, S. (1999). New Challenges and opportunities for Lifelong Learning in South Africa. *35*(2).

Willis, J.W. (2005). *Foundation of Qualitative Research: Interpretive and Critical Approaches.* Thousand Oaks: SAGE Publications, Inc.

Winch, A. & Ingram, H. (2002). Re-defining the focus of workplace learning. *International Journal on workplace environment*, *14*(7), 361–367.

World Bank. (2002)*. It's Not Over When It's Over: Mine Closure Around the World*: *Mining and Development Series.* World Bank and International Finance Corporation, pp19.

World Coal Institute. (2005). *The Coal Resources: A Comprehensive overview of coal*. London: Cambridge House.

Wright, C.K. (2008). *Dimensions of quality: Reflection on current practice*. Keynote address at the Canadian e-Learning Conference, Calgary, Albarta.

Yin, R.K. **(2003).** *Case study research*: *design and methods (*2nd Ed.). London, SAGE Publications, Inc.

APPENDICES

APPENDIX 1: DOCUMENT ANALYSIS OF POLICY DOCUMENTS

APPENDIX 1.1: Skills Development Act of 1998

1. To provide an institutional framework to devise and implement national, sector and workplace strategies to develop and improve the skills of the South African work-force.

2. To integrate those strategies with the National Qualification Framework (NQF) contemplated in the South African Qualification Authority Act of 1995.

3. To provide for learnership that lead to recognised occupational qualification

4. To provide for financing of skills development by means of a levy-financing scheme and a national skills fund

5. To provide for and regulate employment services and to provide for matters connected therewith.

Appendix 1.2: Mid-term report of the Human Resource Development Council of South Africa HRDCSA, Deputy President made on September 2012

1. The skills development problems in our country could be attributed to the weakness in the education and training system, starting from early childhood development and continuing right through the schools and post-schools system and on-going workplace professional development.

2. The HRDCSA is made up of social partners from all segments of society including government, organised labour, organised business, academia and other organs of the civil society.

3. The strategy seeks to ensure universal access to quality to quality basic education that is purposefully focused on dramatic improvement in skills to meet the demands of a growing economy.

4. The council adopted a five-year plan based on strengthening and supporting Further Education and Training colleges to increase access, production of intermediate skills and professionals, and foundational learning.

Appendix 1.3: South African Qualification Authority Act No.58 of 1995

1. Execute the annual remit of the ministers of Education and Labour.

2. Maintain the national framework for standards generation and quality assurance.

3. Maintain and develop the NQF level descriptors.

4. Maintain and develop the register of national qualifications.

5. Maintain and develop the National Learners' Records Database (NLRD).

6. Evaluate foreign qualifications

7. Secretariat to the NQF Forum

8. International liaison

9. Research.

Appendix 1.4: National Qualification Act No.67 of 2008

1. To create a single integrated national framework for learning achievements

2. Facilitate access to, and mobility and progression within, education, training and career paths

3. Enhance the quality of education and training

4. Accelerate the redress of past unfair discrimination in education, training and employment opportunities

5. Contribute to the full personnel development of each learner and the social and economic development of the nation at large.

Appendix 1.5: National Environmental Management Act No.102 of 1998

1. To ensure that South Africa effectively manages the environment for the benefits of current and future generation, according to the Bill of Rights in Section 24 of the constitution.

2. To implement international agreements on the environment.

3. To provide leadership, policy and institutional frameworks.

4. To facilitate effective service delivery in the environmental sector in relation to the national environmental mandate.

5. Need to give attention to skills needed to fulfil mandates.

6. To improve service delivery and results-based outcomes as required by the governmental Monitoring and Evaluation Policy Framework.

APPENDIX 2: DOCUMENT ANALYSIS OF WORKPLACE DDOCUMENTS

APPENDIX 2.1: Environmental Sector Skills Plan

1. Describes the current status quo with regard to demand and supply of environmental skills, and provides the best available information on scarce skills and critical skills in the sector at present from a supply and demand perspective.

2. It also identifies new trends influencing skills development needs in the sector (e.g. new socio-ecological issues and directions, such as acid mine drainage; mainstream of environment into development; and the green economy)

3. It further provides guidance on improving environmental sector skills development planning and implementation within the national education, training and skills development system.

4. It sets objectives for Human Capital Development Strategic Planning for the environmental sector, and provides guidelines for Human Capital Development Planning.

5. It encourages noting that South Africa's education and training institutions and systems are beginning to integrate environmental education and training issues into range of disciplines and programmes.

6. Accordingly, a new window of opportunity has opened to strengthen environmental Sector skills development under the framework of the National Skills Development Strategy III, which pays attention to the government-wide Medium Term Strategic Framework objective of ensuring sustainable use of natural resources.

7. Illustrates clearly that more needs to be done to ensure adequate supply of skills for a well functioning, growing environmental sector.

8. Gives direction and sets out objectives showing how these challenges can be met; provinces, local and national government department and the private sector are all encouraged to draw on the broad directional guidance provided by the ESSP to direct their skills development planning at local and institutional levels.

Appendix 2.2: Mining Qualification Authority (MQA) to the Department of Higher Education and Training. (Sector Skills Plan for the Mining and Minerals Sector)

1. To improve health and safety standards through education and training in the mining sector.

2. Determine skills development priorities after an analysis of the skills demand and trends, and supply issues within the sector.

3. Identify a set of sector specific (skills development) objectives and goals that will meet sector needs, economic or industrial growth strategies, and meet scarce and critical skills needs) in the sector.

4. To support transformation of the sector through skills development.

5. To support objective decision making for skills development through research in the sector. In the planning period of this SSP the MQA envisages the strengthening and improvement of its research function to support decision making regarding skills development in the sector.

6. To enhance knowledge management for skills development in the sector.

7. To facilitate and support the development and implementation of core skills development programmes aligned with the sector qualifications framework.

8. To enhance the monitoring, evaluation and review of the delivery capacity and quality of skills development in the sector.

Appendix 2.3: Human Sciences Research Council

1. There was also a view that instead of considering managerial work as the only progression path, alternatives should be considered in providing older professionals with alternative, perhaps horizontal, pathways, which may include interesting projects that are challenging and multi-disciplinary.

2. Appropriate forms of training for managers may require consideration of short courses in "top up" skills as well as a customised postgraduate degree in the longer term in conjunction with relevant service providers.

3. The lack of career paths was consistently cited as a fundamental constraint in the retention of both new and experienced staff.

4. In most cases, well planned and transparent career options and development paths were non-existent, presenting limited opportunities for advancement.

5. Even where there are some progression paths, for instance at universities (lecture, senior lecture, associate professor, professor etc), the lack of demonstrable financial rewards often rendered advancement insignificant. Thus, many university lecturers engaged in consultancy work to supplement their salaries.

6. A lack of funding to sponsor possible promotions was cited as a more recent occurrence.

7. The Centre for Scientific and Industrial Research was consistently quoted as having an extensive career pathing system and provided clear paths of progression.

8. The research suggests that, there are more fundamental issues underpinning a discussion of career pathing.

Appendix 2.4: Organising Framework for occupation: supporting conservation occupations specialisations: selected OFO codes

1. Botanist (occupation), code 213106

Studies the anatomy, physiology, biochemistry and ecology of plants

Alternative titles and specialisations: Mycologist, Plant Biologist/ Ecologist/ Toxicologist, Plant Breeding Physiologist, Plant Environmental Biologist, Plant morphologist, Plant Pathologist, Plant Pathology Manager, Plant Physiologist, Plant taxonomist.

Task includes: Undertaking research in laboratories and in the field to increase scientific knowledge of living organisms; to discover new information; to test hypotheses; to solve problems in areas such as the environment, agriculture and health; and to develop new products, processes and techniques for pharmaceutical, agricultural and environmental use; Designing and conducting experiments and tests; Gathering human, animal, insect and plant specimens and data, and studying their origin, development, chemical and physical form, structure, composition, and life and reproductive processes; Examining living organisms using a variety of specialised equipment, instruments, technologies and techniques such as electron

microscopes, telemetry, global positioning systems, biotechnology, satellite imaging, genetic engineering, digital imaging analysis, polymerase chain reaction and computer modelling; Identifying, classifying, recording and monitoring living organisms and maintaining databases; Writing scientific papers and reports detailing research and any new findings which are then made available to the scientific community in scientific journals or at conferences for scrutiny and further debate; Designing and carrying out environmental impact assessments to identify changes caused by natural or human factors providing advice to governments, organizations and businesses in areas such as conservation, management of natural resources, the effects of climate change and pollution.

Appendix 2.5: Department of Higher Education and Training: OFO codes and OFO details release (version 10).

1. Mine manager (occupation), code 1322

Mining managers plan, direct, and coordinate the production activities of mining, quarrying and oil and gas extraction operations.

Tasks include:
Conferring with other managers to set production quotas, plan extraction sites and develop policies for the removal of raw materials, controlling the operation of plant and quality procedures through planning of maintenance, designation of operating hours and supply of equipment. Controlling the preparation of production records and reports. Coordinating the implementation of health and safety requirements. Establishing and managing budgets, monitoring production output and costs, and adjusting processes and resources to minimize costs. Evaluating efficiency of production sites to determine adequacy of personnel, equipment and technologies used, and make changes to work schedule or equipment when necessary. Overseeing the acquisition and installation of new plant and equipment Overseeing the selection, training and performance of staff. Planning details of production activities in terms of output quality and quantity, cost, time available and labour

requirements. Researching and implementing regulatory and statutory requirements affecting mineral extraction operations and the environment.

2. Safety, Health, Environment & Quality practitioner (safety officer-occupation), code 226302

Develops, implements and evaluates risk management policies and programs, trains employees in occupational health and safety procedures, monitors and audits the workplace, and records and investigates incidents to ensure safe and healthy working conditions.

Alternative Titles and Specialisations:

Chief Safety Officer Mining

Health and Safety Officer / Coordinator / Professional

Injury Prevention Consultant

Occupational Safety Advisor

Occupational Safety Practitioner / Officer

OSH Advisor / Coordinator / Officer / Professional

Radiation Protection Expert

Risk and Safety Manager

Road Safety Coordinator

3. Environmental scientist (practitioner-occupation), code 213302

Studies and develops policies and plans for the control of factors which may produce pollution, imbalance or degradation of the environment.

Alternative Titles and Specialisations:

Environmental Advisor

Environmental Auditor

Environmental Consultant

Environmental Officer

Environmental Research Scientist

Environmental Waste Officer

Environmentalist

APPENDIX 2.6: Training manual: Employer to provide education and training

1. As far as reasonably practicable every employer must provide employees with information, instruction, training or suspension that is necessary to enable them to perform

2. Ensure that employee becomes familiar with work related hazards and risks and the measures that must be taken to eliminate, control and minimize those hazards and risks

3. As far as reasonably practicable, every employer must ensure that every employer must ensure that every employee is properly trained

4. The employer must keep a record of all formal training provided in respect of each employee in terms of sub section(2)

5. All mines must submit a workplace skills plan and the annual training reports to the mining qualification authority [Sub-s. (5) Added by s.3 of Act No.74 of 2008.]

6. Education and training programmes are a significant factor that can potentially shape and enhance workplace learning.

Appendix 2.7: Mining Qualification Authority (ETQA Guidelines on Learning Delivery 2003)

1. Qualification and learning achievements in the mining industries to improve health and safety standards through proper training and education

2. Standards and competency setting, assessment, examination quality assurance and accreditation in the mining industry.

3. Proposals for the education and training standards and qualifications in the mining industry on the national qualification framework (NQF) referred to in the SAQA, 1995 (Act No.58 of 1995) and 5.2 of the SAQA act determines the objectives of the NQF.

4. Promote the objectives of the NQF in the mining industry

5. Promote the culture of learning in the mining industry

6. Assure the quality of education and training in the mining industry, without itself being a provider of education and training

7. Facilitate strategic human development in the mining industry

8. Liaise with the SAQA, or other bodies, persons or institutions concerned or directly affected by education and training in the mining industry

9. Keep a record of learning for people in the mining industry

10. Perform any function that must be required by the SAQA in terms of the Authority's registration or Accreditation, and

11. Perform any other function that must be performed by the authority in terms of this act or any other applicable law.

Appendix 3: Interview questions

What learning pathways did you use?

EDUCATION AND TRAINING HISTORY

Where did you go to school? What subjects did you take? What did you do after school?

Did you go to the University?

Did you go to college, technikon, university? Which technikon, which university, when were you there?

What courses did you do?

Did you learn about rehabilitation when you were in the school, University College, technikon?

What training programmes have you attended? When, who were they run by? What was the training about?

SKILLS FOR THE PRACTICE

What rehabilitation practices are you involved in? What do you need to know about the rehabilitation practice?

Who taught you to do this?

What skills do one need for rehabilitation practices?

Where did you acquire/got these skills?

Who was you your mentor/teaching you?

Did you go at any short courses?

What short courses? Who offers them? When did you go? How long was the short course? What was the content of the short course? Was it accredited?

SKILLS FOR THE OCCUPATION

What do you do? (Job description)

Did you get on the job training? Who provided it? How often? Did you learn from other people? Who did you learn from?

What skills do you need in order in order to be a practitioner in such occupation?

What knowledge does one need?

Where can one get that knowledge?

COMPANY TRAINING AND TRAINING POLICY

What type of training does the company offer?

Who goes on training?

Who pays for training?

Does the company do workplace skills planning? Are rehabilitation issues included in skills training programmes?

Are there any FET Training?

Who has been teaching you about training?

And how was the experience?

Appendix 4: Observations schedule

Looking at what sustainability practices they are doing

Observe how people are learning the practice.

Observe what knowledge and skills are needed for doing the practice successfully

Looking at the skills and experience with respect to their pathways.

Appendix 5: Induction Training Route

Appendix 6: Consent letters

CONSENT FORM FOR PARTICIPATION IN THE STUDY

PARTICIPANT'S NAME: *P. D. Botha*

DATE: 26·/0·2011

PRINCIPAL INVESTIGATOR: ANDANI MPHINYANE, FACULTY OF EDUCATION, RHODES UNIVERSITY, REPUBLIC OF SOUTH AFRICA

INFORMED CONSENT

1. TITLE OF THE STUDY: Learning Pathways for Improving Rehabilitation Practices In The Mining Industry (for Masters Degree in Environmental Education, Rhodes University)

2. PURPOSE OF THE STUDY: This study seeks to understand how rehabilitation practice knowledge and skills are developed in the mining industry (through examining two case studies). The primary interest is to inform education and training planning. The final results will be used to inform skills development planning in the environmental sector.

3. PROCEDURES: I will first conduct a literature review on the topic. Thereafter, interviews will be conducted with people who are involved in key rehabilitation practices in two mining contexts. The interviews will focus on education and training histories, and how and where knowledge and skills are gained for rehabilitation practices.

4. RISKS AND DISCOMFORT: There are no envisaged risks and discomfort to participation in this study.

5. BENEFITS: Benefits are seen as adding knowledge to the skills development planning to ensure capacity building for the practice of rehabilitation in general with particular emphasis to the mining industry.

6. PARTICIPANT'S RIGHTS: Participants are free to withdraw from participation in the study at any time.
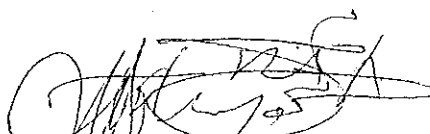
7. FINANCIAL COMPENSATION: There will be no financial compensation for participation in this study.

8. CONFIDENTIALITY: The confidentiality of participants in this study will be ensured through the employment of ethical principles as required by the Department of Education at Rhodes University. Real names of people or the company will not be used in the study report.

9. FOR ANY QUESTIONS: Contact the investigator at 082 843 4800.

I understand my rights as a research subject, and I am willing to give my voluntary consent to participate in this study. I understand what the study is about and how and why it is being done. I will receive a signed copy of this consent form.

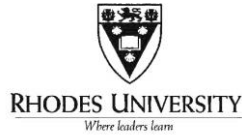Subject's signature   Signature of investigator

Date: 26·/0·2011   26/10/2011

INDUCTION TRAINING ROUTE

NAME: _____ EMPLOYEE CODE: _____

DATE: _____ OCCUPATION: _____

	Safety Induction Signature	General Induction Signature	On-the-Job Signature		Employee's Signature
Engagement Procedure					
Medical examination	Date completed	Examiner	FIT FOR WORK		Restriction
			YES	NO	

MURRAY & ROBERTS CHAIR OF ENVIRONMENTAL EDUCATION AND SUSTAINABILITY

Rhodes University Environmental Education and Sustainability Unit, PO Box 94, Grahamstown, 6140
• Tel:046-603 7276 • Fax: 046-6228028
E-mail: h.lotz@ru.ac.za

June 2011

TO WHOM IT MAY CONCERN

Dear Sir/ Madam

<u>INTRODUCTION OF MR ANDANI MPHINYANI</u>

This letter serves to introduce Mr Andani Mphinyani. He is currently registered as a Masters Student at Rhodes University in the Environmental Education research programme. He is undertaking a study focusing on skills development in the mining sector, with emphasis on the knowledge and skills needed for rehabilitation practices. Mr Mphinyani's study will feed into a larger body of research that is informing skills development planning for environmental occupations.

For his fieldwork he will need to interview practitioners involved in rehabilitation practices. His questions will focus on education and training histories (i.e. how they have developed the skills that are needed for rehabilitation practices); and the current context of training to establish how skills development for rehabilitation practices are gained.

His research proposal has been submitted to the Higher Degrees Committee and he has permission to conduct the research.

We appreciate your support of this initiative.

Sincerely,

Professor Heila Lotz-Sisitka
Murray & Roberts Chair of Environment and Sustainability Education
Rhodes University
South Africa

1