

**A CRITICAL REALIST DIALECTICAL UNDERSTANDING OF LEARNING PATHWAYS
ASSOCIATED WITH TWO SCARCE SKILL ENVIRONMENTAL OCCUPATIONS
WITHIN A TRANSITIONING SYSTEMS FRAME**

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ABSTRACT

Policy, environmental, social and economic factors are all driving South Africa's transition to sustainable development and a greener economy. Various policies have been developed to foster sustainable development in the post-apartheid era in South Africa (i.e. since 1994) and there are various projections on potential job creation for a green economy. However, there is a problem related to both the achievement of sustainable development and green economy objectives: South Africa is said to lack adequately qualified people to implement these goals resulting in what is termed 'scarce skills' in the environmental and sustainable development sector. This problem has, in turn, prompted various skills development studies in the environmental sector, including a national Environmental Sector Skills Plan produced in 2010. All these studies point to a reactive skills development system that provides inadequate learning pathways for existing and newly emerging green occupations, which provided the impetus for a more proactive, transformative praxis oriented system of skills development that supports environmental learning pathways in South Africa. A second problem is that the concept of 'learning pathway' is poorly defined in the South African environmental education and wider education and training policy context. This term is often used in policy discourse within the notion of 'seamless learning pathways' and is only vaguely defined.

This study set out to investigate selected occupationally directed environmental learning pathways in the South African National Qualifications Framework (NQF) and green transitioning context. In attempting to characterise the nature of the environmental pathway, the study utilised critical realist metatheory which serves as an underlabourer for domain specific theory of transitioning societies and systems, life-course transitions and career development. This theoretical work allowed the characterisation of environmental learning pathways as educational and occupational progression. The study investigated the nature of learning and work transitions across the life-course of selected environmental professionals in two key occupational categories – environmental engineer and environmental scientist – both of which have been defined as scarce skills in South Africa. This enabled a nuanced examination of the formation of what emerged as 'boundaryless' career stories of professionals engaged in these two occupations.

The study also sought to engage with a methodological problem in learning pathways research, notably that studies are generally framed either at the micro level career story, emphasising agency of individuals (voluntarism), or at the policy level, emphasising structural aspects of the skills development system (determinism). This study sought to bridge the macro-micro problem

drawing on critical realist retroductive analysis; this facilitated the shift from a focus on events and experiences that can be empirically observed (captured in case study approaches) to the causal mechanisms influencing environmental learning pathways in these two scarce skill occupations (discussed and analysed using dialectical critical realism), shedding light on how systemic and structural dynamics and mechanisms shape and influence the emergence of learning pathways as experienced in scarce skill occupations in the environmental sector.

The opening chapters of the thesis provide an historical view of how the South African education and training system, itself in a transitioning process, has had to grapple with how to respond to and meaningfully take up the new emerging environmental / sustainable development mandate, which is increasingly framed within a multi-levelled transitioning social-ecological system perspective in post-apartheid South Africa. These transitioning systems are shaped by substantive policy imperatives for societal transformation, social justice, sustainable development and equity. Since 1994, various transformations have been taking place, often in paradoxical forms, in both the environmental and educational sectors, shaping a complex multi-levelled transitioning systems perspective for the study.

This background work on transitioning systems provides the foundation for the first data chapter, which provides a descriptive outline of key supply side systemic elements as these pertain to environmental learning pathways more broadly (qualifications; occupational framing; career systems; sector skills planning). It also points to the lack of adequate mechanisms for analysing demand for environmental occupations, and highlights some of the contradictions in the supply-demand relation as these pertain to newly emerging environmental occupations. This helps to explain the empirical findings of previous environmental sector studies on the slow and reactive defining of environmental education and training for environmental occupations within the transforming education and training system in South Africa.

The next two chapters, using case-based qualitative data, present the analysis of the two scarce skill occupations investigated – environmental engineer and environmental scientist. These chapters outline the dominant institutional educational pathway and the key supply platforms that support these pathways (career guidance; qualifications, occupational framings, skills planning) and the learning and work transitions of professionals within the occupation. The chapters highlight the factors and causal mechanisms influencing these learning pathways and thus provide insight into the multi-level dynamics that underpin learning pathways.

The final chapter uses dialectical critical realism to outline generative mechanisms influencing the construction of the learning pathways. It also highlights key absences that are shaping the emergence (or not) of environmental learning pathways, thus pointing to opportunities for how the NQF might respond to the two scarce skill occupations under study, and to the emergence of environmental learning pathways more broadly within the framework of society-in-transition. Through this, the study links the career stories as analysed within the framework of learning pathways and skills system transitioning literature, to generative mechanisms and system development elements. The study concludes with providing occupational and systemic insights into absences and disjunctures that characterise the emergence (or not) of occupationally oriented environmental learning pathways. It also provides insight into what leads to these absences, and how they are kept in place and suggests possibilities and openings for transformative praxis within a multi-levelled transitioning system framework.

The study makes the following contributions:

At a **theoretical** level, the study has shown that environmental learning pathways need to be viewed as a complex phenomenon that is emergent in open systems and constituted by dialectically interdependent planes. A deeper understanding of environmental learning pathways is driven by both educational and occupational progression. It utilises key contemporary ideas around learning and work transitions but links them to the broader analyses of transitioning societies influencing the environmental sector, indicating the significance of how environmental education and training system development is situated within the wider transitioning process oriented towards social-ecological sustainability, social justice and greener economies. This study has further identified green skills as an important focus in research work on transitioning societies.

At a **methodological** level, the study has shown how macro-micro and laminated system research can be useful in studying transitioning systems. As a laminated systems study with a focus on transitioning societies, it provides a baseline for further systems study on green work and green skills.

At a **practical** level, the study has made actual contributions to the conceptualisation of learning pathways in the South African NQF context, to building and informing future green skill developments in the South African post-school system, the environmental sector and to informing conceptualising in the emergent Green Skills project.

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DEDICATION

This thesis is dedicated to my baby girls

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for all you are today and

all I know you will become.

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LIST OF ACRONYMS

ABET	Adult Basic Education and Training
ADEA	Association for the Development of Education in Africa
AIDS	Acquired Immune Deficiency Syndrome
ANC	African National Congress
ANZSCO	Australian New Zealand Standard Classification of Occupations
ASIGA–SA	Accelerated and Shared Growth Initiative – South Africa
ATR	Annual Training Reports
BSocSc	Bachelor of Social Science
BSocSc (Hons)	Bachelor of Social Science Honours
BTech	Bachelor of Technology
BEd	Bachelor of Education
BA	Bachelor of Arts
BA Hons	Bachelor of Arts Honours
BCom	Bachelor of Commerce
BSc	Bachelor of Science
BSc Hons	Bachelor of Science Honours
CATHSETA	Culture Art Tourism Hospitality and Sports Sector Education and Training Authority
CBO	Community Based Organisation
CCRM	Community, Conservation, Resource Management
CESA	Consulting Engineers South Africa
CETA	Construction Education and Training Authority
CHE	Council for Higher Education
CONNEP	Consultative National Environmental Policy
CPD	Continuous Professional Development
CV	Curriculum Vitae
DBSA	Development Bank of Southern Africa
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DHA	Department of Home Affairs
DHET	Department of Higher Education and Training
DHET SIPS	Department of Higher Education and Training – Strategic Infrastructure Programme

DoE	Department of Energy
DoL	Department of Labour
DPE	Department of Public Enterprises
DST	Department of Science and Technology
DTI	Department of Trade and Industry
ECP	Eastern Cape Parks
ECSA	Engineering Council of South Africa
EDD	Economic Development Department
EE	Environmental Engineer
EE & T	Environmental Education and Training
EIA	Environmental Impact Assessment
ELRC	Environmental Learning Research Centre
EPA	Environmental Protection Agency
ESKOM	South African electricity public utility
ESSP	Environmental Sector Skills Plan
ETDP SETA	Education Training and Development Practice Sector Education and Training Authority
ETQA	Education and Training Quality Assurance
EU	European Union
EW SETA	Energy and Water Sector Education and Training Authority
FET	Further Education and Training
GETC	General Education and Training Certificate
FET	Further Education and Training
GIS	Geographic Information Systems
HCD	Human Capital Development
HEMIS	Higher Education Management Systems
HIV	Human Immunodeficiency Virus
HR	Human Resources
HRD	Human Resource Development
HSRC	Human Science Research Council
IAIA	International Association for Impact Assessment
IDC	Industrial Development Corporation
ILO	International Labour Organisation
ISCO	International Standard Classification of Occupations
ISIC	International Standard Industrial Classification

JIPSA	Joint Initiative on Priority Skills Acquisition
JPOI	Johannesburg Plan of Implementation
JSE	Johannesburg Stock Exchange
LG SETA	Local Government Sector Education and Training Authority
MA	Masters in Arts
MBA	Masters in Business Administration
MLP	Multiple-Level Perspective
MQA	Mining Qualifications Authority
MSc	Masters Science
MTSF	Medium Term Strategic Framework
NCV	National Certificate (Vocational)
NDP	National Development Plan
NEMA	National Environmental Management Act
NFSD	National Framework for Sustainable Development
NGO	Non-Governmental Organisations
NLRD	National Learners Record Database
NOPF	National Occupations Pathways Framework
NPC	National Planning Commission
NQF	National Qualifications Authority
NSC	National Senior Certificate
NSDS	National Skills Development Strategy
NSF	National Skills Fund
NSSD	National Framework for Sustainable Development
OECD	Organisation for Economic Co-operation and Development
OFO	Organising Framework for Occupations
OQSF	Occupational Qualifications Sub Framework
PhD	Doctor of Philosophy
PIVOTAL	Professional Vocational Technical Academic Learning Programme
PSET	Post School Education and Training
QC	Quality Council
QCTO	Quality Council for Trades and Occupations
R&D	Research and Development
RDP	Reconciliation and Development Programme
RPL	Recognition of Prior Learning

RSA	Republic of South Africa
SACNASP	South African Council for Natural Scientific Professions
SAICE	South African Institute for Civil Engineers
SANBI	South African National Biodiversity Institute
SAQA	South African Qualifications Authority
SARS	South African Revenue Service
SASCO	South African Standard Classification of Occupations
SDF	Skills Development Framework
SETA	Sector Education and Training Authority
SIP	Strategic Infrastructure Programmes
SMS	Short Message Service
SSP	Sector Skills Plan
STATS SA	Statistics South Africa
STEM	Science, Technology, Engineering, and Mathematics
TIPS	Trade and Industry Policy Strategies
TMSA	Transformational Model of Social Activity
TVET	Technical and Vocational Education and Training
UCT	University of Cape Town
UK	United Kingdom
UKZN	University of KwaZulu-Natal
UN	United Nations
UNEP	United Nations Environment Programme
UNESCO	United Nations Education, Science and Cultural Organisation
UNISA	University of South Africa
WSP	Workplace Skills Plan
WSSD	World Summit on Sustainable Development
WWF	World Wildlife Fund for Nature

CHAPTER 1: INTRODUCTION TO THIS STUDY

The people of South Africa have spoken ... they want change and change is what they will get.

President Nelson Mandela, inaugural speech, May 1994

1.1 Introduction to this study

As South Africa emerges from decades of racial and social oppression, the reality is only now being fully comprehended: Apartheid has left behind a grim socio-ecological legacy that will influence political, social and economic conditions for decades. The development of any sustainability discourse in South Africa is firmly rooted in its turbulent past.

Environmental issues are increasingly seen as complex, multi-faceted and integral to social and economic development. As societies grapple with the rapid and catastrophic effects of environmental degradation, occupational and educational systems have had to attempt to meaningfully comprehend the implications. Within post-apartheid South Africa, these challenges are markedly more complex. In a country facing fundamental national transformation on every front, the environmental/'green' discourse is raising significant new challenges for work and learning systems.

The challenges associated with enabling and understanding the necessary sustainability transitions have occupied environmental educators in South Africa over the last two decades. Against these complexities, the notion of sustainability transitions, the transition to a green economy and the path to a more sustainable future in South Africa have been identified as important foci for further research (South Africa. Department of Environmental Affairs [DEA], 2010a; Lotz-Sisitka, Ramsarup, Gumede, Togo, & Rosenberg, 2013). This chapter lays the foundation upon which this research is conceptualised, implemented, reported and reflected on.

1.2 Understanding the broader research context

1.2.1 South Africa: Overview of the broader landscape

South Africa is situated at the southern tip of Africa, bordered by both the Atlantic and Indian Oceans. Known colloquially as the 'Rainbow Nation', it is a country renowned for its diversity of cultures, languages, and religious beliefs. South Africa has eleven official languages, with English being the most commonly spoken language in official and commercial life, but only the fifth most spoken home language. The 2011 census revealed that the most spoken language is isiZulu (20%),

followed by isiXhosa at 16%, Afrikaans at 13,5 % and English and Setswana at 8,2% (STATSSA, 2012).

According to the latest available census data, South Africa has a population of 51 770 560, of which 26 581 769 (51.3%) are female and 25 188 791 (48.7%) are male. The population grew by 15.5% (or 7 000 000 people) in a space of ten years (STATSSA, 2012).

Table 1.1: South African population distribution

SA's POPULATION: CENSUS 2011		
Population group	Number	% of total
African	41 000 938	79.2%
White	4 586 838	8.9%
Coloured	4 615 401	8.9%
Indian/Asian	1 286 930	2.5%
Other	280 454	0.5%
TOTAL	51 770 560	100%

(STATSSA, 2012)

Before 1994 the country comprised of four provinces: the Transvaal, Orange Free State (largely Boer Afrikaner), the Cape and Natal (once British colonies). Scattered between these were the 'homelands' where Black South Africans were forced to live and have citizenship. Post-apartheid and with a democratic constitution, South Africa was divided into nine provinces as illustrated in the map below (Figure 1.1).



Provinces:

Limpopo
Gauteng
Mpumalanga
KwaZulu-Natal
Western Cape
Northern Cape
Free State
North West
Eastern Cape

Figure 1.1: Map of South Africa

The province where I live, Gauteng, is the country's geographically smallest but economically busiest province. It has both the biggest and the fastest growing population, and according to the census of 2011, its 12.2 million people reflect a 33.7% increase since 2001, more than double the national average increase (STATSSA, 2012).

This rapidly growing population has placed severe strain on the fragile socio-ecological landscape as illustrated by the discussion below.

1.2.2 South Africa: A society in transition

All aspects of South African society have undergone change over the last two decades. Some have referred to this as South Africa's "triple transition – toward political democracy, economic liberalisation, and racial equity" (Cunningham, Lynham, & Weatherly, 2006). The discussion below explores some of these issues in South Africa. Table 1.2 shows societal change across basic elements of society to illuminate the dynamics of some of this transition, namely size of population, employment and unemployment statistics, access to services, literacy and numbers collecting social welfare.

Table 1.2: South Africa now and at the dawn of democracy

(Redrawn from Goldman Sachs, 2013)

Description	1996	2011
Population (m) - Total	40.6	51.8
- African	31.4	41.0
- Other	9.2	10.8
GDP (\$bn)	143.7	402.2
Unemployment (millions)	4.7	5.6
Employment (million)	9.0	13.2
Functional literacy	33.6%	19.1%
Access to services (%)		
- Electricity	58.2%	84.7%
- Water	60.8%	73.4%
- Sanitation	50.3%	62.6%
Social welfare (millions)	2.4	14.6

The African population has grown significantly in the post-apartheid years and currently accounts for 79% of the total population. This population group is therefore an important determinant of the political and economic life of the country.

The non-cash transfers by the state in the provision of public goods and services is seen in the improvement of functional illiteracy from 34% to 12.1%. STASSA (2012) reported that 93% of South Africans can read and write and 57% of learners have benefitted from 'no fee' schools. A further increase in access to electricity and access to water and sanitation has been recorded by STATSSA (2012) as well as Goldman Sachs (2013). Other positive changes according to the STATSSA General Household survey of 2012 included the increase in access to public health care (70% of households used public healthcare), the access to landlines or cellular telephones and access to

the Internet. It has to be acknowledged that complex challenges remain in all of the above areas, but we still appear to have made significant progress.

South Africa's problems are well publicised, in particular its triple challenge of HIV, unemployment and poverty, which affects the lives of a third of the population (see Figure 1.2 below). HIV/AIDS can have a debilitating effect on education in a country where 4.6 million live with HIV. HIV can impact on education in three key ways: it can affect the supply of education through the availability of teachers/lecturers, the demand for education (total number of students and the number enrolled and staying in education) and the quality of education (supply of experienced staff) (Gachuhi, 1999).

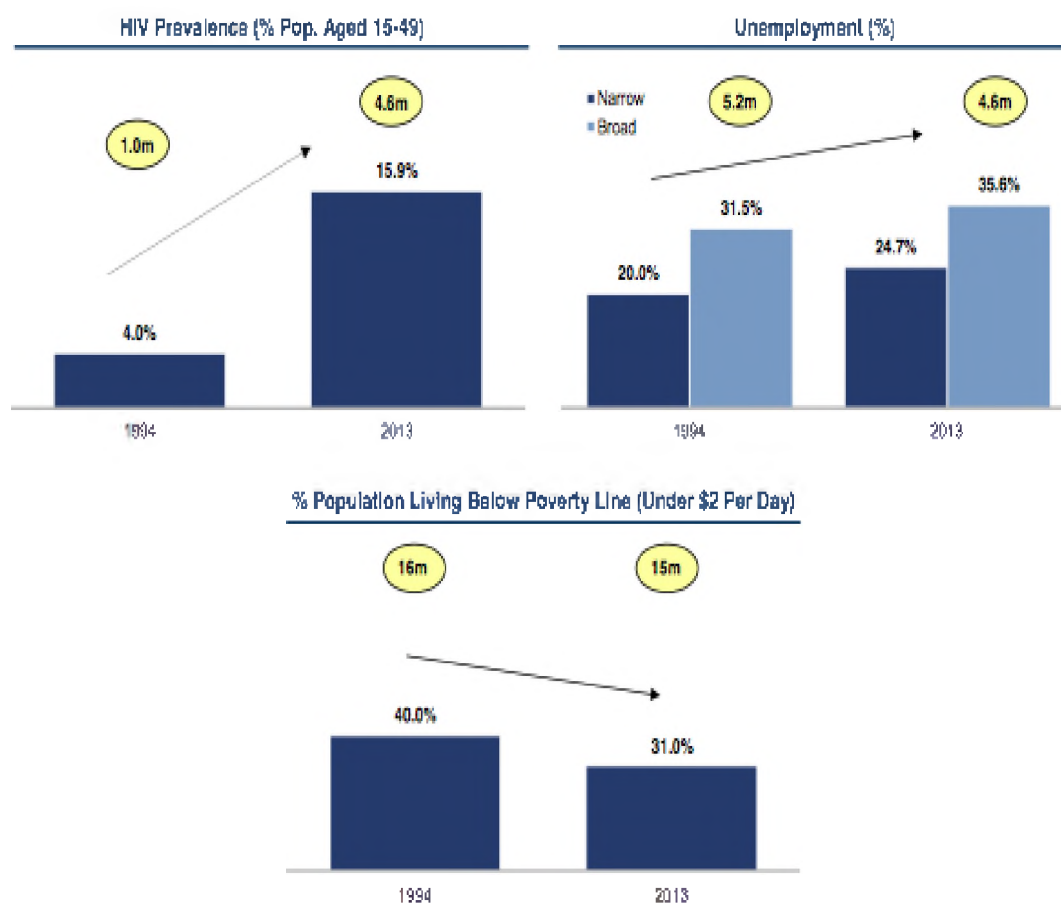


Figure 1.2: South Africa's triple challenge
(Redrawn from Goldman Sachs, 2013)

Although there has been a reflected growth in employment as outlined in Figure 1.2 above, the employment growth has not been significant enough to meaningfully reduce unemployment. As can be seen below, narrow unemployment (those that are currently not working but are willing and able to work and are actively seeking work) has risen to 25% due to the economic crisis and

global slowdown. Of grave concern to the education and training systems is that 70.6% of the unemployed are youth between 15-34 years and one third of the 15-24 year olds were not in employment, education and training. Furthermore 51% of the labour supply has not completed matric (Grade 12) (Goldman Sachs, 2013; STATSSA, 2012). High unemployment for young people could be indicative of a shortage of post-school educational opportunities (STATSSA, 2012). The tragic consequences of these high levels of unemployment are reflected in the worrying poverty levels as shown in Table 1.3 below, which clearly illustrates the poverty scenario within the nine provinces in South Africa.

Table 1.3: Population living below poverty lines

(South Africa, 2012 – The Presidency Development Indicators Report)

NUMBERS AND PERCENTAGE OF POPULATION LIVING BELOW NATIONAL POVERTY LINES (2011 CONSTANT RAND PRICES)						
Province	R305		R416		R577	
	Number	%	Number	%	Number	%
Eastern Cape	2 347 900	35.7	3 357 900	51.0	4 350 360	66.1
Free State	708 917	24.6	1 210 984	42.0	1 667 389	57.8
Gauteng	1 066 930	10.1	1 912 081	18.1	3 052 436	29.0
Kwazulu-Natal	3 346 038	33.0	4 670 201	46.1	6 098 481	60.2
Limpopo	2 568 243	48.5	3 292 120	62.1	3 936 212	74.3
Mpumalanga	1 157 765	32.1	1 715 310	47.6	2 252 275	62.5
Northern Cape	903 412	26.3	1 441 929	42.0	1 955 353	56.9
North West	293 371	26.0	479 855	42.6	655 653	58.2
Western Cape	479 081	9.0	944 728	17.8	1 625 180	30.6
South Africa	12 871 658	26.3	19 025 108	38.9	25 593 339	52.3

Of significance is that more than two-thirds of the households in Limpopo and the Eastern Cape, respectively, live below the R577 (approximately \$52) poverty line against the national average of 52.3%. In the more affluent provinces of Gauteng, poverty headcount levels are about 30%.

South Africa's skewed distribution of income makes it the most unequal society in the world. Van der Berg (2002) argued that poverty and equality are strongly rooted in the labour market. Key challenges remain which include the labour force participation rate of 56.6% that is significantly lower than the rates of comparable countries (South Africa. National Planning Commission [NPC], 2011a; 2011b). Additionally, the labour market absorption rate of the formal economy has steadily declined since 1985 (South Africa. NPC, 2011). Both these labour market conditions present a critical challenge to the country but especially to youth. In terms of these demand side constraints, Mlatsheni (2014) highlighted the issue of aggregate demand (job availability) as a key constraint

followed by labour demand (the types of jobs available). Aggregate demand is influenced by factors like the recent global economic downturn, which exacerbated the constraints on employment creation as these impact on employment availability and the nature of the jobs available.

The above discussion clearly illustrates the complex historical legacies and challenges that any education planning in South Africa would need to comprehend and accommodate. The massive race and class inequalities inherited from apartheid remain intricately woven into our contemporary reality. Any movement to a sustainable society within South Africa would require a transition that addresses socio-economic inequalities as emphasised by Swilling and Annecke (2012). It will need to be a '*just transition*', one that reconciles sustainable use of natural resources with the idea of sufficiency and equality of opportunity. Thus, central to the transition of South Africa's economic discourse, is an underlying social justice approach.

1.2.3 Challenges in the ecological landscape

South Africa is a country with a rich biodiversity and exceptional ecosystems, habitats, abundant non-renewable and mineral resources. But the country also faces several ecological challenges that place severe strain on its natural resources. Some of these are outlined below in more detail.

South Africa is one of the world's biodiversity hotspots with large protected world heritage sites. Despite this, species loss is an important and complex issue here. Forty-one bird species are deemed threatened (5.44% of total bird species in the country) and thirty-one species are listed as near threatened. There are twenty-three threatened mammal species (7.74% of the mammal population in South Africa). Seventeen species of amphibians are threatened amounting to 14.4% of total amphibians. A total of nineteen reptile species of forty-four are currently threatened. Furthermore, 40% of terrestrial ecosystems are threatened (9% initially endangered, 11% endangered, 19% vulnerable) (Organisation for Economic Cooperation and Development [OECD], 2013; South Africa. DEA, 2012).

South Africa is one of the world's top twenty emitters of greenhouse gases. Renewables currently account for only 1% of total energy generation. The energy sector is the largest and fastest growing source of CO₂ emissions due to the predominance of a coal-based energy structure (74%) and electricity supply (94%) (OECD, 2013). The South African economy is largely reliant on water-intensive (1.5 litres/1kg coal) coal-fired power for energy (70% of primary energy). Growth is

carbon intensive due to the reliance on coal-fired electrical power (OECD, 2013; South Africa. DEA, 2012).

Cheap water (and energy) has historically been the backbone of macro-economic growth in South Africa, which has involved externalising costs to social-ecological systems. Demand pressure for economic growth is greatest in the Limpopo and Orange River basin systems, which sustain 70% of the total national economy. South Africa also captures the major portion of the water shared with Lesotho, Botswana and Namibia, Swaziland and Mozambique in transboundary river catchments. Water prices in the sub-Saharan region are expected to rise as much as 40% in the medium and long-term (Muller, 2007). In terms of freshwater ecosystems, 82% are officially classified as threatened, 50% of wetlands have been destroyed and 36% of fish are threatened (Peter & Swilling, 2011; OECD, 2013; South Africa. DEA, 2012).

By 2025, it is estimated that 70% of South African citizens will reside in cities and towns. Limited landfill space, increasing waste volumes and higher environmental protection standards are raising the costs of waste disposal for all waste generators. Domestic waste charges will increase by 18% in 2010 and landfill disposal fees will increase by up to 38% (Peter & Swilling, 2011; OECD, 2013; South Africa. DEA, 2012).

The global food system is characterised by environmental degradation, high dependency on fossil fuels and marginalisation of small farmers and high levels of food insecurity amongst poor rural and urban households.

The discussion above provides a brief illustration of the ecological reality, which is tied to any notion of change to a more sustainable future. Like elsewhere around the world, a transition to a new relationship between people and planet is necessary. These two brief sections illustrate the socio-ecological reality that we have to contend with as we explore issues of sustainability transitions.

1.2.4 The green growth path and transition to a green economy: An emerging landscape pressure

Changes in the global economy and global climate have increased uncertainty and promoted greater short-term unpredictability and non-linearity and subsequently increased vulnerability to resource scarcity. Global responses to these pressures have prompted significant interest and growth in the green sector as a viable employment sector (Peter & Swilling, 2011). In this section, I briefly introduce the green economy as a multi-pronged development paradigm that has elevated

the profile of environment as an economic driver both globally and locally. A more detailed discussion is provided in Chapter 3, but a useful orientating definition is provided below:

A green economy is one in which the vital links between economy, society and environment are taken into account and in which the transformation of production processes, production and consumption patterns while contributing to a reduction per unit in reduced waste, pollution, and the use of resources, materials; create decent employment opportunities, promote sustainable trade, reduce poverty and improve equity and income distribution. (GIZ Scoping Mission Report, 2011, UNEP Global Green Deal, 2009)

The South Africa, National Development Plan (South Africa, National Planning Commission, 2011a) together with the New Growth Path (South Africa, National Planning Commission, 2011b) set a solid framework for supporting the transition to a green economy. The New Growth Path lists the green economy under job driver 3: 'Seizing the potential of new economies' and the National Development Plan lists 'Environmental Sustainability and Resilience' as one of its objectives. This support remains extremely significant, as funding is an important mechanism that flows out of strong policy commitment. The *Business Day* newspaper (May 13, 2014) reported that South Africa's emerging new growth path is "taking measures to adapt to the low-carbon economy by coupling fiscal sustainability with national development to ensure that progress made will not be interrupted or reversed".

The Development Bank of South Africa (Maia et al., 2011) commissioned a report that provided a segmented view to government of the net direct green job creation anticipated to emerge in the formal economy highlights job creation potential as follows: within energy generation – 13 500 jobs in the short term and 130 000 in the long term; within energy and resource efficiency 31 500 jobs in the short term and 68 000 in the long term; in emissions and pollution mitigation 8 400 in the short term and 32 000 in the long term. The report also pointed out that due to South Africa's extensive natural capital, job creation in natural resource management will dominate over both the long term and short term. It estimated a 45% increase in job creation in natural resource management in the short term and 50% in the long term (Maia et al., 2011). For a more detailed discussion on potential jobs in the transition to a green economy, see Chapter 3.

Green jobs have enjoyed strong political support as they are being widely promoted as enabling us to alleviate poverty as well as to "contribute directly to preserving or enhancing environmental quality in a sustainable low-carbon economy, protect ecosystems and biodiversity, reduce energy, materials and water consumption through high efficiency strategies, de-carbonise the economy

and minimise or altogether avoid generation of all forms of waste and pollution” (United Nations Environmental Programme [UNEP], 2009).

The explanation of an integrated eco-social approach by Raworth, Wykes and Bass (2014) that integrates sustainability priorities and social justice priorities with economic opportunities and constraints, is critical to achieving green and just economy.

As interest in the opportunities presented by the green growth path escalates, so too does the recognition that investment in green skills planning is critical for long-term performance of a greener economy. The environmental practices envisaged within green jobs cross elementary, intermediate and high skills levels and will therefore require different learning pathways. This will necessitate transversal engagement across the National Qualifications Framework (NQF) as sustainability practices are located across schooling, higher education, and occupationally directed training. This emerging scenario will further burden the currently overextended and inefficient skills development system in South Africa (see Chapter 6, for a more detailed discussion on green skilling in South Africa).

In the preceding sections I have provided a brief orientation to key landscape pressures that are critical to the unfolding background of this study. The discussion has highlighted broad dimensions of the social, environmental and economic crisis in South Africa. This lays the foundation for understanding the policies and programmes which are important mechanisms to support green economic development (see section 3.2.1.1.) and provides a deeper contextual understanding of the unfolding green economy discourse (see section 3.2.1.3.). Together they help me to illustrate the growing field based imperative for green skilling in the context of increasing severity of risks linked to environmental change issues, emergence of new environmental policies and new job and labour market demands.

1.3 Conceptualising the study

This study had no related previous South African research to draw on so I had to develop a conceptual understanding of the meaning of learning pathways within the South African National Qualifications Framework. There has been no previous work on environmental occupations in South Africa and there is very little data in relation to environmental skills development. There have been a few small scale qualitative research projects (conducted mainly by environmental agencies) around isolated areas like environmental careers but they remain insufficient to produce a coherent knowledge base. Studies in mainstream education starting to emerge are focused on

graduate employment and the race gender mismatch (Koen, 2007); post-school youth focused on those not in employment, education and training (Cloete & Butler-Adam, 2012); and transition from school to higher education (Cosser, 2010). These all provide some initial research contexts for the study design.

In this section I explain three interrelated aspects that shaped the conceptualising and design of this study:

- my own involvement in the field;
- a brief background to what was happening in the sector in South Africa at the time; and
- the South African Qualifications Authority (SAQA)/ Rhodes University research programme.

1.3.1 Background to a study on learning pathways for green skills

Post-apartheid South Africa has developed clear policy frameworks that prioritise and elevate the importance of the environmental agenda in response to dire environmental challenges facing the country. The Medium Term Strategic Framework (MTSF) (2009-2014), Strategic Priority 9, relates to sustainable resource management and use: this sets a foundation for governmental responses at all levels for integration of this strategic priority into governmental activities. This strategic priority is complemented by the National Environmental Management Act (NEMA) drafted in 1998. Since NEMA, South Africa has passed legislation in many areas of environmental protection as discussed in section 3.2.1.1.

All these (relatively new) acts place additional responsibilities on environmental implementing agents, local governments and private enterprises, to ensure they meet minimum standards in each expanding policy mandate. Environmental practitioners thus need a broad range of (new) interdisciplinary and emerging skills (including resource economics, modelling and forecasting, as well as 'mainstreaming' environment into development, stakeholder engagement and advocacy). This requires sophisticated and *sector specific skills planning* (Human Sciences Research Council [HSRC], 2009; South Africa. DEA, 2010a; South Africa. DEA, 2010c).

Despite the National Qualifications Framework's (NQF) commitment to responsive skills, development and lifelong learning, several recent studies have highlighted that there are many skills and competence related issues within environmental provisioning and that "new skills and retraining needs for the greening sector should filter successfully through the 'demand and supply' process" (International Labour Organisation [ILO], 2010, p. 19). However, research to date (HSRC,

2009; South Africa. DEA, 2010a) indicates that while there is a skills development focus and a greening focus, there is little articulated alignment between the two, a finding confirmed by the International Labour Organisation on 'green skills' in South Africa (ILO, 2010, p. 19). Environmental skills development and planning is happening in pockets of praxis, but uptake and upscaling into the skills development landscape is limited (South Africa. DEA, 2010a) This skills development misalignment is discussed in further detail in Chapter 6.

Two major national studies addressing these issues (HSRC, 2009; South Africa. DEA, 2010a) show that the broad and cross-cutting environmental 'sector' has neither a dedicated Sector Education and Training Authority (SETA) nor organised industry bodies to drive skills development. As a cross-sectoral concern, environmental skills planning was meant to be integrated across all SETAs (HSRC, 2009; South Africa. DEA, 2010a; 2010b). However, a short study by Lotz-Sisitka, Malema and Olvitt (2004), involving a desktop review of five SETA Sector Skills Plans (SSPs), highlighted that SSPs were being developed without giving adequate attention to the skills requirements associated with sustainable development policy and legislation relevant to the sector. The study also revealed that there were varying interpretations of environment and sustainability issues in the SSPs that were not consistent with those in the National Environmental Management Act of 1998.

Consequently, planning and provisioning for environmental skills development in South Africa has been "inadequate, ad hoc, fragmented, reactive and inefficient" (South Africa. DEA, 2010a, p. 5). Despite expanding mandates, the studies listed above collectively estimate shortages of over 800 environment-related scientists and 1 500 environment-related technical skills in the public sector, affecting service delivery and implementation of core national legislation. Despite a dire need to up-skill staff, environmental agencies have been unable to source SETA funding effectively (FN11; FN13; FN15; South Africa. DEA, 2010a; 2010b). Employers tend to provide generic training at levels too low to address identified skills needs and line function budgets are often used to provide more relevant training (South Africa. DEA 2010a; 2010b), which reflects inefficient use of funding at a broader systemic level. There is also very little evidence of skills development initiatives (outside of short courses in universities) that are providing direction for coping with new environmental challenges or new environmental policy directives. For example, while the National Environmental Management: Waste Act (No. 59 of 2008) requires a 'cradle-to-cradle' approach to waste management or an avoidance approach, most of the training in the waste management sector involves end-of-pipe approaches (South Africa. DEA, 2010a).

Conceptualising skills development needs within a context where tomorrow's jobs will be different from those we know today, is challenging and requires new models of proactive skills planning that can comprehend what skills will be needed in 10 to 15 years. This represents a challenge to a sector that is struggling to develop a co-ordinated focus on green skilling.

To consolidate the problem elaborated above, sustainability practices are contested and complex and research in the sector (HSRC, 2009; South Africa. DEA, 2010a) has shown that the whole system of training provisioning for workplace learning and sustainability practices is poorly constituted and unresponsive to the rapidly changing nature of the sector. This foregrounds the contention that there are issues between the environmental sector (where certain new forms of training are needed) and the education and training system that is not geared to offer such training. Within the context of this reactive system, the need for research and the conceptualisation of a more proactive, transformative praxis oriented system of green skills development in South Africa is essential.

Furthermore, to enable more seamless and responsive transitions into environmental occupations, Lotz-Sisitka (2011) argued that it is critical that we broaden insights into environmental learning pathways and how they are constituted, which hence form the basis from which this study is conceptualised.

1.3.2 Tracing the development of a research interest

This study has been informed by my extensive engagement within the field of education and training. I have worked in exploring environmental learning issues at schools, education district offices and local government in different work contexts, NGOs as well as within provincial and national government. At national government level I worked as a technical advisor within the National Environmental Education Programme, supporting the development of environmental learning as integral to the curriculum and educational reforms in South Africa within school based education (Grade R-12). Thus I have worked at various levels of the education and training system and have spent a significant part of my work life looking at policy and systemic issues related to environmental learning. During my career I have gained substantial experience in engaging with sustainable development as a transversal issue, which requires attention and engagement at all levels of the NQF. Throughout this work, I have encountered and worked with the challenges of trying to integrate a 'new' discourse into a system and society in transition.

This work experience prompted my interest and participation as a researcher in the development of an Environmental Sector Skills Plan for South Africa (ESSP) (South Africa. DEA, 2010a). This document, which was the first of its kind in South Africa, illustrates the status quo related to supply and demand of skills, identifies new trends in skill development in the environmental sector and provides the most comprehensive overview of critical issues facing the sector to date. The ESSP drew attention to the various dimensions of the problem such as the slow defining of environmental occupations and training and elevated the need for systems attention to green occupations. It provided various insights into the centrality of developing better understanding/s of learning pathways into the sector, and their emergence within the sector. During the data collection for the ESSP, there were many occupations mentioned in workplaces and occupational discussions but they were impossible to find and track in the educational system. There appeared to be an obvious gap in understanding of environmental occupations, one that was not well understood within the education and training system. Subsequently I was involved in two career studies within the Biodiversity sector in which similar questions were raised and which solidified my interest in understanding learning pathways into green jobs.

I could see that there was a need to understand how people had transitioned into these green jobs and to track their educational progression so that the education system could become more responsive. The issue of a lack of clarity on learning pathways has been repeatedly noted in national studies focussing on capacity in the environmental sector for responding to contemporary environmental challenges and risks (see South Africa. DEA, 2010a; HSRC, 2009).

1.3.3 South African Qualifications Authority / Rhodes University Research Programme

This PhD study is situated within a Rhodes University / South African Qualifications Authority (SAQA) research partnership. The programme, in its first phase, comprised two PhD and two masters students focusing on change oriented learning and sustainability practices, and in its second phase, one PhD (myself) and four masters students. The research programme lies at the nexus of two important areas for development, policy, and education namely, work and learning and sustainable development.

This second phase of the SAQA / Rhodes research programme aimed to investigate the nature of learning pathways for environmental protection, sustainable development and a green economy

in South Africa.¹ It focused on what learning pathways exist and are possible for environmental practitioners, with a view to identifying articulation points and coherence of how knowledge and practice is engaged in different sites and in different occupational /work contexts across the National Qualifications Framework (NQF).

In setting up this study I, as lead PhD researcher on the team, together with colleagues in the research programme, reviewed literature and research across different sub-fields of education and training and social theory, including:

- career development research – to understand career formation and how career development and transitions are represented;
- skills development research in South Africa – to understand issues and progress being made with regard to skills development;
- green economy documents and green skills planning;
- learning pathways research – to search for a suitable construct to conceptualise a learning pathway as an ‘empirical object to study’;
- learning and work transitioning;
- critical realist research; and
- systems theory research – to understand how research on ‘whole’ education and training systems could be undertaken.

The study thus drew on existing work across all these sub-fields to conceptualise a research design that would allow me to understand how learning pathways in and for sustainable development of society emerge and are constructed (or not).

1.4 The search for a researchable question

1.4.1 Learning pathways for green skills

Against this background, this study uses a lens of the learning and work transitions in environmental learning pathways to explore the complexities associated with pathway construction, articulation and efficacy in systems of provisioning. Wheelahan (2009) argued that putting pathways at the centre of an education system helps to bring many parts of the system

¹ These three foci are not unrelated, but also signify a broad focus for environmental education and training in the NQF, or for Education for Sustainable Development, a term used by UNESCO to explain the area of education and training that takes account of the interrelated nature of society, environment and economy.

into direct relationship with each other and thus helps us to raise questions on how qualifications and curriculum provide for educational progression. Investigating the nature of pathways helps to create better flow within education, improved connections between education and work and improved development and use of skills at work (Wheelahan, Moodie, & Buchanan, 2012).

Central to the framing of the study was the idea that “pathways need to be premised on continuity and complementarity if they are to support educational and occupational progression” (Wheelahan, 2009, p. 6). These ideas are supported by the Organisation for Economic Co-operation and Development (OECD) report on redefining tertiary education, which stated:

Articulation is not a mechanical matter of formal recognition of qualifications, or of prior learning experiences, necessary as these may be. It is also a learning concept, implying complementarity, continuous enhancement or development of competencies, achievement and progression along a pathway that is personally meaningful and has a social recognition and status. (OECD, 1998, p. 51)

A number of authors have recognised that various professions are experiencing a heightened sense of transitions (Evetts, 2009; Sawchuk & Taylor, 2010; Fenwick, 2013). Field (2012) reflected that the boundaries and expectations of transitions though the life course are changing, at the level of the individual and at the level of the wider society. An OECD report (2008) noted that transitions are increasingly fragile and exclusionary and that the number of ‘stepping stones’ required by youth to secure a labour market position is multiplying. Within this, individual learning and work transitions are becoming more challenging (Sawchuk & Taylor, 2010). Individuals are thus being called on to manage transitions throughout their careers – beginning with the shift from initial professional education to workplaces. All these perspectives raise the critical need for education and work systems to pay attention to **experiences of transitions**. In a South African context of understanding ‘real learning pathways’ within the environmental sector, the traditional supply and demand approach to understanding was insufficient; hence trying to understand the transitions people were making became an important lens in constructing the nature of the learning pathways.

The notion of **transitions** is thus an important concept for understanding wider systemic articulation concerns, as it provides both structural and systemic insights. A study of the transitions also provides empirical insights into how various qualifications may or may not articulate, and how the changing context shapes choices and needs related to available qualifications, how they are used, and how they relate to more traditional qualifications-led articulation learning pathways. Hence their relevance and interest to a research programme on

learning pathways within an NQF that has sub-frameworks that define and frame how qualifications can enable or constrain what has been referred to in (DHET) policy discourse as 'seamless' learning pathways (South Africa. Department of Higher Education and Training [DHET], 2011b).

The terms 'learning pathways' and 'lifelong learning' are now being increasingly used together in policy circles. The interlocking of pathways with lifelong learning raises the goal of 'pathways engineering' (McKenzie, 2000b; Vaughan, 2003) beyond ensuring that all school leavers gain a qualification that enables them to obtain a full-time job. This is leading to various studies focussing on 'transitions' in lifelong learning (Field, Gallacher, & Ingram, 2009). Field et al. (ibid.) traced this research to the current condition of 'constant change' in which new drivers of change such as globalisation, the movement of neo-liberal capital, new technologies, science-based innovation, mobility and the search for competitive advantage, individualisation of values and lifestyles, and environmental change are all seen to be influential in 'forcing' a context in which 'life transitions' become a focus of sociological engagement and research. High modernity and the globalisation of capital and climate change are shaping an ever more uncertain world, with new life and work challenges such as is being demonstrated by the imminent need to re-shape whole economies and societies for a low carbon future (increasingly captured in the notion of a 'Green Economy', UNEP, 2009). Bauman (2001) and Giddens (1990) both commented on the conditions of late modernity, the need for ongoing reflexivity, and noted that lifelong learning (and the flexible learning pathway) becomes the main educational consequence of such conditions (Lotz-Sisitka & Ramsarup, 2012b). Field et al. (2009) noted that transitions research in the context of youth transitions to university is comparatively mature and is increasingly giving attention to the relationship that exists between youth agency within a recognition of structures and constraints and is "informed by theoretical understandings of learning lives in late modernity, sometimes conceptualised, following Ulrich Beck, as 'risk society'" (e.g. Walther et al. (2006) as cited in Field et al., 2009).

Given this context, this study's design, presented in Chapter 2, will utilise a more complex notion of learning pathways as neither completely individualistic nor wholly structurally determined. The concept of learning pathways used in this study will be informed by the critical realist recognition that structures precede human actions *and* that agents may influence structures and exercise reflexivity as they 'make their way through the world' (Archer, 2000). Based on this emergent view of human development, the perspective on learning pathways used in this study will recognise

that systemic and structural factors shape learning pathways in certain ways, but agents (the individual learner or other corporate agents) may shape the learning pathways in certain ways too.

1.4.2 Choosing an occupational focus

Occupations are a strategic context for studying life transitions (George, 1993). Job shifts (vertical and lateral moves, as well as movement in and out of the labour force) are transitions, and careers are the trajectories within which job shifts occur. This study is not a study on occupational emergence (it is not documenting the emergence of a new occupation in the tradition of occupational sociology) nor is it undertaken from a labour theory perspective but as an educational study, it uses the lens of an occupation as an heuristic tool to organise work on learning pathways and allowed me to explore the dynamics of transition empirically in contextually specific ways rather than depict them in generic terms as no particular transition pathway could ever be relevant in all contexts.

Working with new or emerging occupations also presents some challenges due to the lack of institutional and official data related to these occupations. There are no coherent records of tracking or categorisation of occupational data and this also constrains access to an established occupational community. As corroborated by Hammond (2012), in this study I also found individuals in emerging occupations difficult to identify and survey. In the absence of data sources for people who identify themselves as environmental professionals both currently and historically, the study tried to develop the most coherent empirical picture possible. Hammond (ibid.) also claimed that research on new and emerging occupations tends to be qualitative.

Within this study I worked with two occupations with nine to ten practitioners within each occupation to develop an in-depth emancipatory understanding and ‘explanatory critique’ (Sayer, 2000) of their career stories. To develop this level and quality of insight, it was necessary to place the analysis of the career stories alongside and within an analysis of the wider systems of learning pathways provisioning and construction, to understand both generative causal mechanisms and absences (Sayer, 2000).

The two occupations selected were environmental engineer and environmental scientist (see Chapters 7 and 8). Each presented very different tasks, contexts and experiences of boundary-less work (Arthur & Rousseau, 1996). The engineering sector is well regulated by a dynamic professional body. The key underpinning interest in selecting this occupation was to understand how people crafted a pathway into this ‘new specialised occupation’ and how the education and

training system provisioned for this occupation. The environmental scientist was selected as within workplace skills planning, this occupation always emerged as a scarce skill, but there was very little broader understanding of reasons for the scarcity and little understanding of the occupation generally (FN11; FN13; FN15; In 10). Thus both occupations selected have been repeatedly identified as scarce skills within South Africa (South Africa. DHET, 2013b). In Chapter 6 I outline the processes involved in the identification of scarce skills in South Africa. It should be noted that I had originally started the study with three occupations, the final two chosen that are discussed above and the environmental technician, for being the only technical occupation widely available in the sector to raise the pathway dynamics for technical routes. I did collect career stories for this occupation but due to the scope and bulk of data for the study, I eventually made the decision to confine the study to the two scarce skills occupations.

1.4.3 Designing the study

The study design (see Figure 1.3 below) involved a) a 'biographied career story' research linked to practitioners from two occupations (Chapters 7 and 8), and b) system elements analysis (Chapter 6), but c) subjected these career stories and systems perspectives to critical realist dialectical analysis (Chapter 9), in order to d) identify absences that need absencing at a systemic level, and then to e) establish the manner in which the NQF as a differentiated system may be (better) able to respond to the absences identified (Chapter 9). This enabled placing the institutional pathways with the related provisioning systems alongside the personal career stories.

The diagram below presents a more substantive approach to learning pathways research. It presents a visualisation of how career stories in the two occupations were studied as integral parts of the provisioning system and its related sub-systems. In Chapter 4, some of the conceptual work related to learning pathways and the critique of theoretical eclecticism is presented.

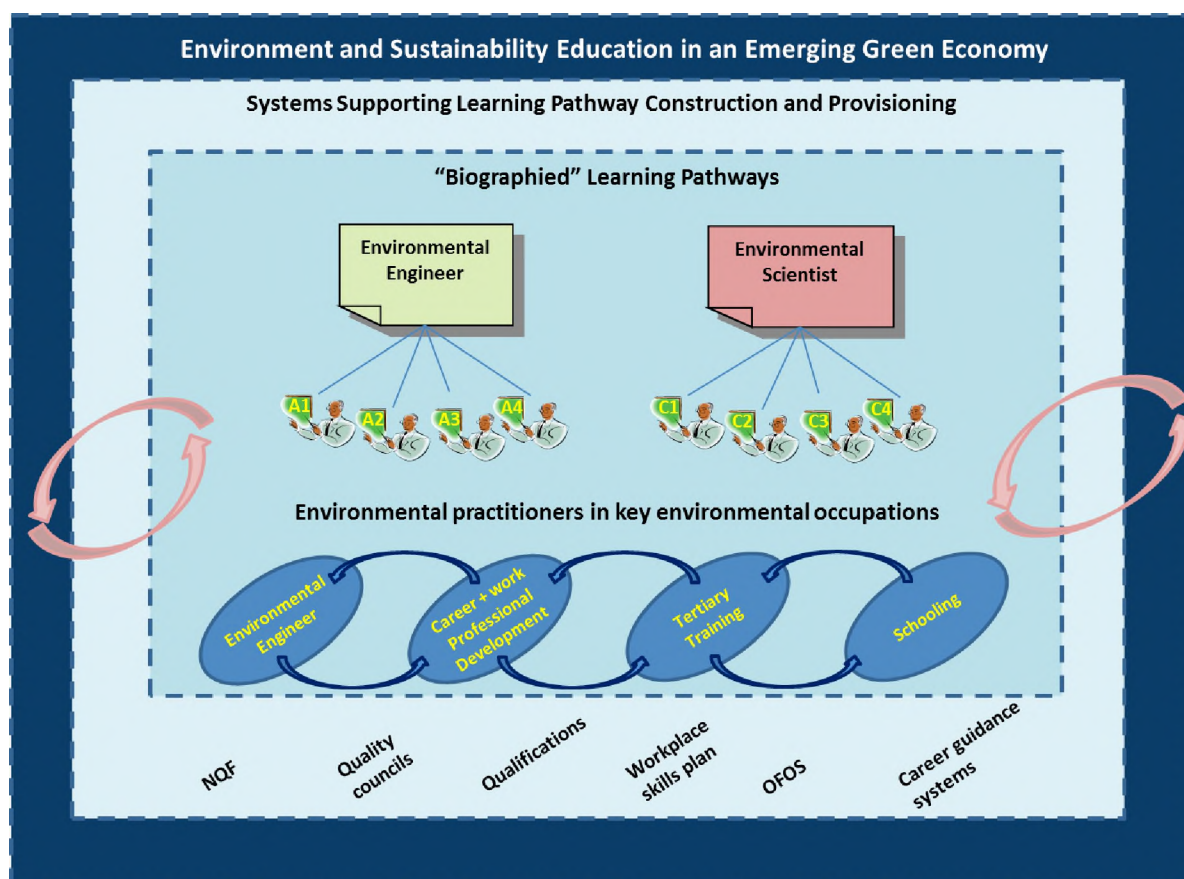


Figure 1.3: Overview of key embedded components of the study

1.4.4 Research aims and objectives

The overall research aim of this study is to provide an emancipatory analysis of environmental learning pathways that takes account of the 'holistic whole' and possibilities for transformative praxis (Bhaskar, 1993). Scott (2010), writing from a critical realist perspective, helped to clarify what adopting a critical perspective implies:

Adopting a critical approach necessarily implies that a state of affairs is flawed or incomplete and therefore needs to be replaced by an alternative, which is not flawed or incomplete in the same way ... an emancipatory agenda indicates progress towards a better state of affairs than currently exists. (p. 105)

The study thus makes no pretence of neutrality and accepts that intimately tied to an understanding of being is the notion of becoming (Bhaskar, 1993), which solidifies the emancipatory impulse in this study. Thus in trying to understand the nature of the environmental learning pathway, its intent is to provide opportunities for transformative praxis.

This will allow an understanding of how 'individuals' in key environmental occupations gain access to, use and navigate the learning opportunities in a complex national education, training and skills

development system. The study also explores how this system and its differentiated sub-systems determine and shape learning pathways through what is present, but also through what is absent. In this way, it enhances understanding of the factors that enable and constrain access to learning opportunities and learning pathways in a newly emerging field of practice, and how these emerge and come to be constituted. In terms of change, the study seeks to identify future directions for transformative praxis in the area of learning pathways development for environmental protection, sustainable development and a green economy in South Africa.

1.4.5 Research question

The core question that has guided this study is:

What learning pathways exist for key environmental occupations and how are these shaped by the interplay of systemic factors, agentic factors and/or absences?

To achieve the study's aim and respond to the research question above, the study has the following objectives:

- Objective 1: Understand the nature of environmental learning pathways in two key environmental occupations and how they emerge and are shaped.
- Objective 2: Identify system and structural factors and mechanisms influencing articulation and access issues relevant to learning pathways associated with the key occupations.
- Objective 3: Probe and identify absences in learning pathways associated with the two key occupations, in order to provide explanatory critique and emancipatory 'direction' for transformative praxis in learning pathways in the environmental sector.

1.5 Some ideas underpinning the study

1.5.1 Scope of the environmental sector in South Africa

Developing an understanding of the environmental sector is a critical underpinning contextual dynamic to this thesis. The Department of Environmental Affairs (DEA) as the lead agent for environment in South Africa has outlined the scope of the environmental sector in its strategic plan (2012-2017): all government departments have a responsibility for implementing an environmental mandate. The Constitution establishes a governance system that forces "all spheres of government and all organs of state" to cooperate with one another in "mutual trust and good

faith” (Constitution – Act 108 of 1996) (South Africa, 1996). This co-operation should therefore be taking place across and within all departments.

The National Environmental Management Act (NEMA) no. 107 of 1998 is a good example of an act emphasising cooperative governance. The following government departments are listed in the Act as exercising functions that may impact on the environment and as such are required to develop environmental management and implementation plans:

- Department of Environmental Affairs and Tourism
- Department of Land Affairs
- Department of Agriculture
- Department of Housing
- Department of Trade and Industry
- Department of Water Affairs and Forestry
- Department of Transport
- Department of Defence
- Department of Minerals and Energy
- Department of Health
- Department of Labour. (South Africa. 1999, p. 92)

Each government department listed above needs to “prepare a consolidated environmental implementation and management plan”; this plan needs to be updated every four years (South Africa. 1999, p. 18). This sets a framework for co-operative governance of the environmental sector.

The Environmental Sector Skills Plan (ESSP) (South Africa. DEA, 2010a) utilised the following focus areas to illustrate the sector: air quality, waste and chemicals management, pollution incident management, environmental impact management, conservation and sustainable use of biodiversity, marine and coastal management; this also includes cross-cutting support functions such as environmental law and compliance, environmental education (South Africa. DEA, 2010b, p. 6).

From an employment perspective, the scope of employers also needs to be considered in the environmental sector. Although a full employer audit has not been done in South Africa, the ESSP (South Africa. DEA, 2010a) defined employer types in order to frame a fuller scope and detail of

employers in the sector. Types of employers include:

- Public sector (national government) – employees across a large number of government departments (Department of Agriculture, Forestry and Fisheries; Department of Trade and Industry etc.) but the Department of Environmental Affairs remains the largest employer (DEA, 2010a).
- Public sector (provincial government) – every province is required to perform policy implementation functions therefore there are environmental employees in various government departments. Normally environmental functions are linked to economic affairs, rural development, tourism or agriculture (ibid.).
- Public sector (parastatals) – a range of state-owned enterprises employ environmental staff, especially those that have key mandates for environment such as the South African Biodiversity Institute, South African National Parks, South African Weather services, ESKOM (electricity public utility in South Africa). At a provincial level, mainly the parks and conservation parastatals employ environmental employees, for example, East Cape Parks, Ezemvelo KZN Wildlife, Cape Nature, Mpumalanga Parks Board (ibid.).
- Public sector (local government) – all municipalities should be employing environmental employees as all have an environmental mandate to fulfil. Areas within local government include health and waste management as well as integrated environmental management. The DEA 2010a report noted that that municipal level employment is dominated by elementary occupations.
- Private sector (Big Business) – the short extract illustrates the progress currently being made in South African Private Sector.

Overview of 2014 Johannesburg Stock Exchange, Stanford Research Institute (SRI) Index Review:

- 156 companies were assessed (2013, p. 157)
- 82 of the companies assessed qualified for the SRI (2013, p. 72)
- 8 companies are in the index for the first time
- 9 companies have been identified as best performers (2013, p. 6) and 4 of these companies have been identified as best performers for the first time. (Stanford Research Institute [SRI], 2014)

South African company reports (those listed in Johannesburg Stock Exchange) are required to report on environment, society, governance and related sustainability concerns as well as climate change in an effort to promote integrated reporting. These companies all employ environmentally skilled staff.

- Private sector (small and medium enterprises SMMEs) – these range from small consulting companies to large consultancies. Also in this category are private game farms. South Africa also has a large environmental consulting community that is growing (South Africa. DEA, 2010a).
- Non-governmental organisations (NGOs) and Community Based Organisations (CBOs) – South Africa has a number of NGOs and CBOs working with environmental issues.

This discussion provides an illustrative picture of the scope of the sector over the various focus areas and disciplines, employers and scope of coverage by government departments. This develops a picture of a complicated framework for policy and governance of the environmental sector.

1.5.2 Sustainability transitions

Sustainability discourses are inherently ambiguous, contested and uncertain (Swilling & Annecke, 2012). I have hence chosen to use a heuristic to frame how I will organise my ideas on the transition to sustainability (introduced in more detail in section 2.2.). The multi-level perspective (MLP) is widely utilised as a conceptual tool to frame dynamics of transition to a more sustainable society in a more coherent way. The transition as the desired pathway in achieving sustainable development is viewed as “a continuous process of societal change, whereby the structure of society (or a subsystem of society) fundamentally changes (Van der Brugge & Rotmans, 2006).

The MLP is a simple but highly flexible heuristic framework that enables us to view sustainability transitions as non-linear processes. It helps to understand and interpret transitions as the interplay of developments at three analytical levels (see below), which interact dynamically in the unfolding transitions. These three levels are:

- At the macro-level the ‘landscape’ is determined by changes in the macro-economy, politics, population dynamics, natural environment, culture and world views (generally represents the exogenous context). This level responds to relatively slow trends and large-scale developments that canalise the evolution of a particular societal system (Peter & Swilling, 2011);
- At the meso-level, there are patterns of institutions, artefacts, rules and norms assembled and maintained to perform economic and social activities which are referred to as the ‘regime’ (Berkhout, Smith, & Sterling, 2003); and
- At the micro-level there are so-called ‘niches’ of individual actors, alternative technologies

and local practices that deviate from the status quo manifesting themselves as new ideas, initiatives or innovative techniques (Kemp, Schot, & Hoogma, 1998).

It is important to bear in mind, as explained by Geels (2010), that these levels are NOT ‘ontological descriptions of reality’ but rather that they can be utilised as broad analytical and heuristic concepts that illustrate the complex nature and dynamics of the change inherent in the transition to a sustainable society. The relation between the levels must always be viewed as a ‘nested hierarchy’ (Geels, 2002; Geels, 2010).

In this chapter, I have tried to describe some landscape pressures, as the socio-technical landscape is sensitive to the global economy and to changes in global and regional climates and resource flows. The emergence of the green economy, scarcity of resources such as oil, the drive to decoupling as a foundation for economic growth, global climate change, water scarcity and energy supply limitations all form ‘landscape pressures’, as discussed by Swilling and Annecke (2012). Across this thesis, the MLP framework allowed me to connect and explore the changing nature of learning pathways as they manifest as part of the “emergence of niche innovations that tend to respond to the tension that opens up between new landscape pressures and the regime that does not know how to change” (Peter & Swilling, 2011, p. 15). Chapter 2 explains the MLP in greater detail and explores its relation to critical realism within this study.

1.5.3 Skills: A complex discourse

The skills development discourse, within which the study is situated, needs further clarification. Firstly, there is need to acknowledge that skill is a concept that has limited meaning without reference to knowledge, values and attitudes. Often within field-based practice ‘skills’ are used as ‘occupational categories’ as well as to refer collectively to “knowledge, values and skills to fulfil environmental mandates” (South Africa. DEA, 2010a, p. 6).

Sawchuk (2006, drawing on Warhurst et al., 2004) proposed some basic forms of consensus around the ideas of skill and work and outlined three principles as key to most relevant work:

- skill includes internalised capacities resident in the individual worker;
- skill includes job design, divisions of labour, technology and control; and
- skill is socially constructed.

Writing from a South African perspective, Allais (2011; 2012) contended that the conception of skill is contested and is socially and politically constructed. Allais drew on the classic argument of Charles Tilley (1988, as cited in Allais, 2011; Allais, 2012)

As a historical concept, skill is a thundercloud: solid and clearly bounded when seen from a distance, vaporous and full of shocks close up. The commonsense notion – that ‘skill’ denotes a hierarchy of objective, individual traits – will not stand up to historical scrutiny; skill is a social product, a negotiated identity. Although knowledge, experience and cleverness all contribute to skill, ultimately skill lies not in characteristics of individual workers but in relations between workers and employers, a skilled worker is one who is hard to replace or do without. An unskilled worker is one who is easily substitutable or dispensable. (Allais, 2012, p. 634)

Allais further contended that these individualist mind-sets trap skills development in a classic “self-help, employability and labour market flexibility discourse” that works against improving actual levels of education and skills. A very real consequence of this individualist framing relevant to this thesis is that workers that have skills not formally recognised tend not to be a recognised category of skilled labour (Allais, 2012, p. 634).

McGrath (2004) further clarified that skills policies never exist on their own and thus interact intimately with other policies as represented in the diagram below (which has been drawn from McGrath’s 2004 discussion (blue areas in diagram below)). In the context of this study, it would be important to add to McGrath’s discussion, that it is essential to connect skills policies to broader social and environmental policy as these have significant implications for skills policy as will be illustrated across this thesis. In Chapter 3 I outline the transitioning processes within the environmental and educational systems with an intention to understand their co-evolution.

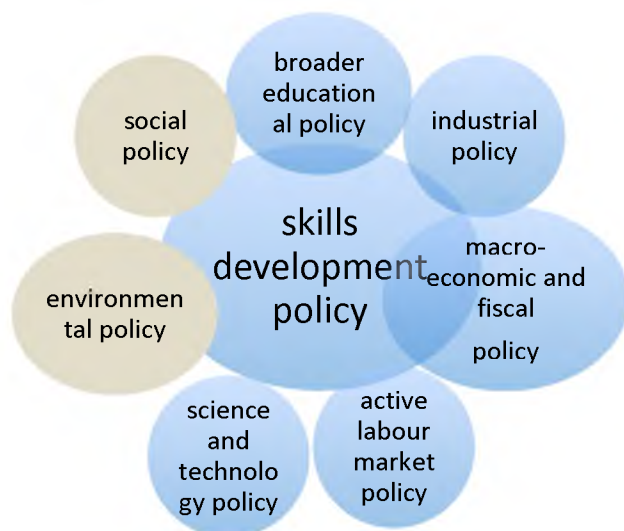


Figure 1.4: Interaction of skills policies with other major policies

From its troubled past, South Africa's apartheid-driven industrial development path led to a highly polarised skills landscape between 'high skills' and 'low skills', which was also characterised by a racialised and gendered system of skills development. With this context of poverty, unemployment and social inequality, it is important that national economy is not viewed as a 'single monolithic entity' (Kraak, 2003; McGrath, 2004).

Kraak (2003), McGrath (2004) as well as Kraak and Press (2008) all argued for a model depicting greater economic differentiation and segmentation for interpreting skills. They claimed that if the economy is viewed as multi-layered it can be argued that there are three skill bands associated with three differentiated economic sectors: High Skills, Intermediate Skills and Low Skills (see Table 1.4 below). This lays the foundation for a 'multi-pronged approach' to simultaneous up-skilling (Kraak, 2003), which is significant to South Africa for three important reasons, as outlined by Kraak and Press (2008, p.vi):

- It refutes the thesis driven by globalisation and knowledge economy discourses that high skills are prerequisites for participation in the new economy. It rather emphasises that high skills are not the only skills in demand and workers with intermediate and low skills form the largest percentile of the employed.
- There has been a serious neglect of the importance of intermediate skills in contemporary economies.
- In an economy characterised by great poverty, unemployment and low levels of labour absorption, the expansion of entry level jobs in labour absorbing sectors is crucial.

Table 1.4: Skill differentiation within the South African NQF (Adapted from Kraak, 2012)

SCHOOL GRADE	NQF LEVEL	Education Band	Skill Differentiation
Grade 1-9	NQF Level 1	General Education and Training Band (Schooling)	LOW (ENTRY) SKILL
Grade 10	NQF Level 2	Further Education and Training Band	
Grade 11	NQF Level 3		
Grade 12	NQF Level 4		Higher Education and Training Band
	NQF Level 5		
	NQF Level 6		
	NQF Level 7		
	NQF Level 8		
	NQF Level 9		
	NQF Level10	HIGH SKILL	

This skill differentiation framework provides the study with an important typology for a new sector to understand differentiated skill formation and critically assess how an emerging sector is framing its approach to *skills development*, used here and across this thesis to refer to all “education and training which is aimed at the workplace” (Allais, 2012).

In Chapter 3, section 3.2.2.2 I discuss the emergent construct of Green Skills in greater detail.

1.5.4 Dealing with the human capital assumptions underlying this thesis

I am aware that this study, which is focused on learning pathways into scarce skill occupations, is inherently based on the idea that there are skill shortages. Underlying this are various human capital assumptions. In the discussion below, I provide a brief overview of human capital discourse and try to illuminate some of the core assumptions of this discourse and its relevance to the environmental sector.

Schultz (in Bouchard, 1998) and Becker (1975) are some of the main proponents of human capital theory. Drawing on Becker (1964), human capital may be defined as any economic investment in the ‘ability and potential’ and ‘knowledge’ of a person from which an economic rate of return or profitability may be garnered (HSRC, 2009). Becker (1975) saw investment as:

- formal education which may be obtained at formal institutions;
- on the job training which may be technical and specific to a company; and
- migration.

Fundamental to the human capital thesis, which is widely used in the skills sector is the idea of rate of return, which is seen as return to individual, the organisation or to society. The environmental sector though is located largely in the public or government sector with state-based parks, conservation parks, state research, botanical gardens, NGOs and community development. The sector thus provides goods and services that are mostly of a public good nature. Thus this is not a sector driven by pure economic or commercial returns on investment (HSRC, 2009).

However, my intent here is generally to illustrate that traditional human capital critiques and assumptions do not have great utility in the environmental sector as fundamentally, the link between education and economic gain is not the only priority focus in this sector. Hence the decision not to use for framing of this thesis.

1.6 Outline of the thesis

Chapter 1 provides an orientation to South Africa as a transitioning society and lays the foundation for understanding the triple challenge (poverty, unemployment and HIV) facing South Africa.

These challenges are vastly compounded by the escalating ecological crisis. This discussion lays the foundation for the argument for the support of a green pathway out of poverty and a social justice approach to the emerging green economy. The chapter then introduces conceptualisation of the study and the framing of the research questions and objectives.

Chapter 2 outlines the shaping of a conceptual and theoretical framework for the study. It begins by introducing the open systems framework of the Multi-Level Perspective (MLP), which enables the framing of sustainability transitions as a multi-level concept. The chapter then deepens the MLP framework with a critical realist underlabouring that argues for a stratified and differentiated reality. Through the two open systems frameworks introduced in the chapter, I was able to reconfigure environmental learning pathways as a multi-level concept within a laminated system with embedded emergent properties, that ultimately sets the frame for the thesis.

Chapter 3 focuses on the environmental and educational policy contexts as meso systems in transition. It highlights how the increasing severity of environmental risks and issues has catapulted policy responses at all levels. This has escalated a field-based imperative for green skilling as new emerging job demands surface, both in South Africa and internationally, with the envisaged transition to a green economy (ILO, 2010b; ILO, 2011c). This locates environmental learning pathways as embedded within environmental and educational discourses. The chapter, through its transitioning tale, provides the historicity and contextual background for the three empirical chapters (Chapters 6, 7 and 8).

Chapter 4 presents a conceptual understanding of learning pathways research. Within the context of new emergent and changing environmental occupations, I chose to represent the learning pathways as educational and occupational progression. The chapter highlights how I drew on *learning and work transitioning across the life course* as a lens to understand the empirical nature of the learning pathway. The chapter then also introduces the critical realist dialectic, which enabled the study to connect being with becoming. This dialectical framing allowed the study to surface possibilities for transformative praxis for green skill learning pathways.

Chapter 5 explores the methodological processes followed in the study and how the critical realist philosophy influenced how data was generated, analysed and managed. It illustrates how the

three empirical cases were framed and how data was gathered within and across cases. It also illustrates how field based reflexivity was engaged across the study at various stages, to enable sector resonance.

Chapter 6 explores the emergence of green skills within the post-school sector through a review of the main supply side platforms that are critical to systemic articulation and the enabling of learning pathways. The chapter then highlights from the review some of the critical patterns of emergence in relation to green skilling within the post-school sector in South Africa.

Chapter 7 and Chapter 8 present empirical data on the two occupations (environmental engineers and environmental scientists) that formed the main focus of the learning pathways analysis in this study. **Chapter 7** presents the context of environmental engineering in South Africa. It presents an in-depth analysis of nine environmental engineers, and reports on the main findings related to the intersection of institutional and individual pathways of environmental engineers. It ends by highlighting the factors influencing learning pathways for environmental engineers.

Chapter 8 presents the context of environmental science in South Africa. It presents an in-depth analysis of nine environmental scientists' learning pathways, and highlights the main findings related to the intersection of institutional and individual pathways of environmental scientists. It ends by highlighting the factors influencing learning pathways for environmental scientists.

Chapter 9 summarises the multiplicity of causes and hence multiplicity of mechanisms and structures that influence the nature of environmental learning pathways when viewed as a laminated system. Using the dialectical critical realist lens, the chapter then raises the key absences in the learning pathways and highlights opportunities for transformative praxis. This frames a transfactual argument for further development of learning pathways for green skills. The chapter ends by highlighting the main conclusions and recommendations of the study, including recommendations for further research.

1.7 Conclusion

In this chapter I have tried to develop a contextual background that sets the scene against which the study develops its vantage point on environmental learning pathways within a transitioning society and post-school system. This provides background to the research, the questions and objectives and the rationale behind the design of the study. It introduces the overall conceptual and theoretical framework and briefly outlines the way I have structured this thesis.

CHAPTER 2: BUILDING A FRAMEWORK TO UNDERSTAND PATHWAYS WITHIN A TRANSITIONING SOCIETY

*South Africans of many races, colours, cultures and religions are hard at work to achieve peace and national reconciliation. Proud of the fact that they are Africans and moved by the fact that the peoples of Africa share a common burden of conflict, poverty and underdevelopment, they are determined to work hand in hand.
... understanding the umbilical cord that ties us to the planet earth,
they are determined to do everything possible to save the earth from ourselves, to save the earth for ourselves ...*

Excerpt from President Thabo Mbeki's address at the welcome ceremony
at WSSD on 23 August 2002

2.1 Introduction

As the era of change swept over the country, South Africans began to adapt to the idea that we live in a transitioning society. In Chapter 1, I explored some aspects of the transitioning context pervading the contextual landscape for learning and work transitions, which are the overall foci of this study. In this chapter, I provide an orientation to the two frameworks that underpin this study – the multi-level perspective on transitioning and the underlabouring critical realist framework.

I first explore the concept of transitions for sustainable development, which are an implicit aspiration of all legislation introduced in the environmental sector. This will allow me to illustrate the concept of transition used as a conceptual and explanatory tool. To enable a more in-depth analysis, of how I frame transitions and the deeper structures and mechanisms that underlie surface level events and experiences, I then introduce a critical realist underlabouring. Together these two frameworks introduce the reader to the theoretical and conceptual framework that shaped the design and implementation of the study (unpacked further in Chapters 3, 4 and 5).

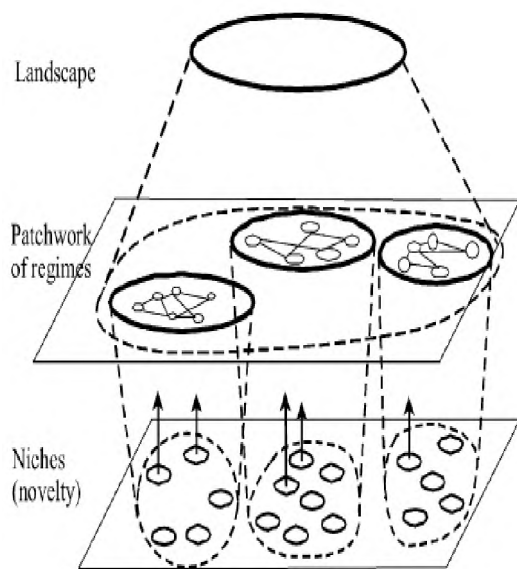
2.2 Transitions to sustainable development

In Chapter 1 I briefly introduced several environmental problems facing the world today. Geels (2010) explained that these problems differ in scale and complexity from the environmental problems in the 1970s and 1980s; they require, he argued, much more than merely cleaner technologies. The changes needed to address contemporary challenges require substantive transitions involving changes in markets, user practices, policy and cultural meanings. The difficulty is that the status quo of societal systems is maintained by historically constituted **lock-in**

mechanisms that relate to “behavioural patterns, sunk investments, vested interests, infrastructure, subsidies, regulations” (ibid. p. 495). He therefore introduced the multi-level perspective (MLP), which, as explained in Chapter 1, was a widely utilised conceptual tool to frame dynamics of transition to a more sustainable society. In this section I elaborate on this framework and illustrate its usefulness to this study.

2.2.1 Multi-level perspective

Chapter 1 briefly introduced the multi-level perspective, with its three interacting levels as depicted below:



The three levels are represented as a nested hierarchy. The nested character means that regimes are embedded within landscapes, and niches within regimes (Geels, 2002).

Figure 2.1: Multi-level perspective as used in mainstream sustainability transitions discourses

The societal landscape at the macro level is affected by changes in economy, politics, culture, demography, natural environment and worldviews (van der Brugge & Rothmans, 2006; Rothmans & Kemp, 2003). Within the regimes, operate the social norms, interests, rules and belief systems, which underlie companies, organisations, institutions and policies of political institutions. Rothmans and Kemp (2003) explained that the interest here tends to be driven by optimising rather than transforming. At the micro level lie individual actors, technologies and local practices, this is where variations from the status quo occur. MLP allows us to recognise that interactions between the different levels are intimately connected to any transition.

Swilling and Annecke (2012), van der Brugge and Rothmans (2006), and Rothmans and Kemp (2003) all explained that transition processes are characterised by the following:

- Multi-actor processes that engage actors in unpredictable ways from all sectors (public, private, non-profit);
- Multi-domain processes;
- Multi-level processes;
- Long-term, continuous processes;
- Reconfiguration of the institutional and organisational structures and systems of society (Rothmans and Kemp (2003, p. xvi);
- Set of interconnected changes which reinforce each other but take place in different areas (several developments in different domains at different levels come together to reinforce each other);
- Multi-change concept: during a transition new structures emerge and existing structures are broken down;
- At a further conceptual level, the multiple stages of a transition are explained as a 'multi-phase concept' – a transition is a sequence of the following four phases: pre-development, take-off, acceleration and stabilisation (see Figure 2.2 below).

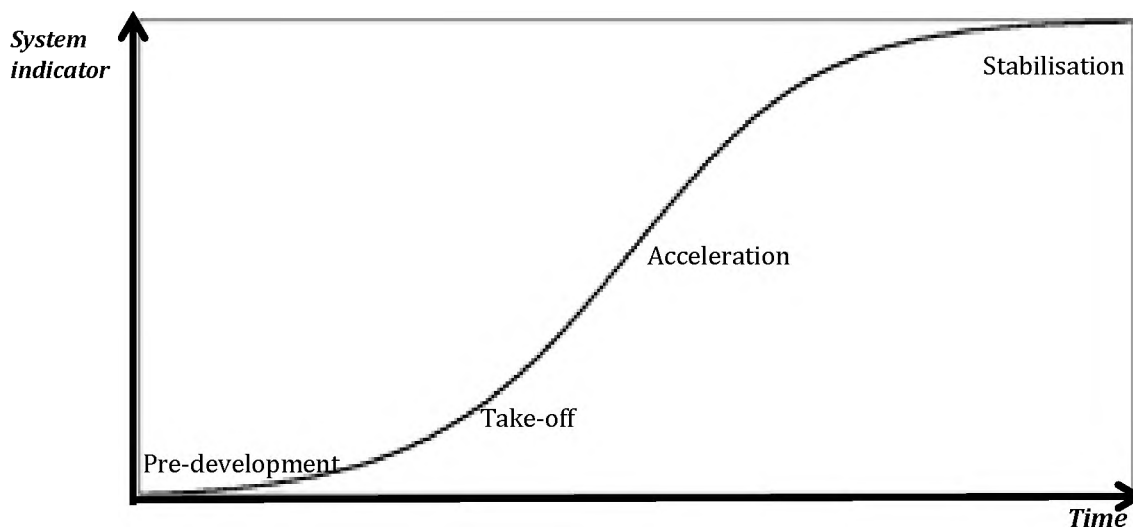


Figure 2.2: Stages in transition

This study is inherently about understanding the co-evolution of the education and environment sub-systems towards a transition pathway to greater sustainability. The MLP and the explanatory tools it offers became useful to me as explained by Peter and Swilling (2011) and Swilling (2012), as they provided me with the descriptive tools to work with the broad (global) and regional

landscape pressures that exert pressure on the regime (the regime has little control over the latter and must adapt) (Peter & Swilling, 2014): **“It helps to explain the lock-in at regime level and why regime change is unlikely without niche innovations’** – at early pre-development, the regime (the ‘system’ that is evolving and changing) often acts as an inhibiting factor – as it seeks to maintain social norms, beliefs, the general status quo” (Peter & Swilling, 2011; Swilling & Annecke, 2012). Within this it is possible to argue that **landscape pressures actually open up spaces and opportunities within the regime for change**. The changes are **driven by niche developments**: “emergence of niche innovations ... tend to respond to the tension that opens up between new landscape pressures and the regime that does not know how to change” (Peter & Swilling, 2011, p. 15). Niche innovations could thus be policy, discursive or technological (Peter & Swilling, 2011). Rothmans and Kemp (2003) explained that regimes change in response to bottom-up pressures from the micro level, or top-down pressures from the macro level. Through reinforcement at all levels, regimes begin to transition to different modes of operation.

2.3 A critical realist ontology

Underlabouring the transitioning work with critical realism in this study enabled philosophical engagement and ontological depth so that problems of positivism (ontological actualism), hermeneutics (epistemic fallacy), ecological fallacy and methodological individualism could be avoided. In the discussion below, I introduce some of the underpinning critical realist ideas as they will provide the foundation for the shaping of the theoretical framework of the study.

2.3.1 Stratified ontology

Critical realism represents an important point of epistemological departure from mainstream realism and the basic tenet that there is a reality beyond what we know and understand (Sayer, 2000), the real being intransitive while knowledge and theories of the real are transitive. It represents a shift from epistemology to ontology, and within ontology, a shift from events to mechanisms (Danermark, Ekstrom, Jakobsen, & Karlsson, 2002; Togo, 2007) while allowing for epistemological relativism. Critical realism proposes a three-part “depth ontology of the real (structures, underlying generative mechanisms), the actual (phenomena and events, generated by underlying structures/ causal mechanisms) and the empirical (phenomena and events experienced by the knowing subject)” (Norrie, 2010; Sayer, 2000). Figure 2.3 illustrates by way of an example how this has been interpreted within this study.

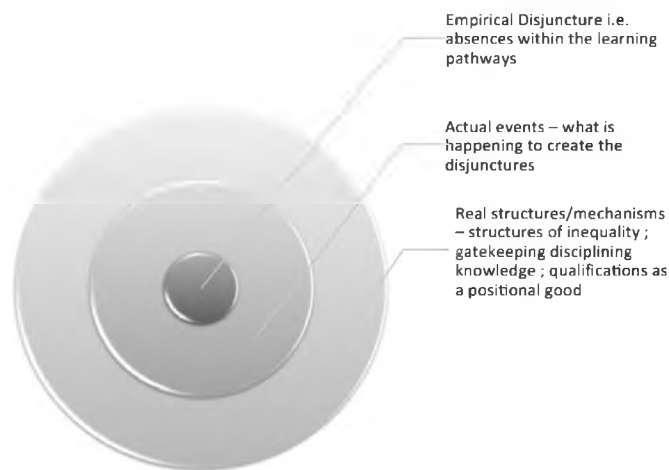


Figure 2.3: Stratified ontology within this study

The real world is “relatively independent of the patterns of events and the actions of men alike” (Bhaskar, 1998b, p. 41). Thus it is from these generative mechanisms that the second layer emerges. Here, the actual content of the events are considered, when and if generative mechanisms are activated. It is from these events that the third layer emerges. It comprises the empirical forms, which frame the realm of human experiences and observations. In this study, these perspectives were critical in working with the biographied learning pathways (Chapters 7 and 8).

It is important to note that both the generative mechanisms of the real and the events of the actual are not necessarily reflected in the experiences of the empirical (Lindley, 2014). Therefore, one cannot rely on the empirical to reveal the causal effects of the research phenomenon.

In the empirical domain, it is possible to identify experiences of knowing subjects (e.g. the taxonomist or environmental engineer who reflectively share their biographied learning pathway and how it came to be constructed). In the actual domain, one can identify events and their experiences by subjects (e.g. how a particular course or degree programme shaped the learning pathway of the taxonomist or environmental engineer). In the domain of the real, one can identify both experiences and events, and the *underlying mechanisms that generate these events and make them available to experience* (e.g. how the existence of an academic stream in university education allowed for the taxonomist to study taxonomy and thus become a taxonomist; or how the policy of transformation or the change in power relations in society influenced the chance to obtain a management position).

Rather than focus on regularity then, critical realism helps us understand that causal laws exist qua emergent properties that exist in open systems. Causal laws can interact in a number of ways. So the observed effects of causal laws are always contingent upon a particular configuration of causal laws having effects which at a particular point happen to interconnect with the effects of other causal laws.

Thus, instead of perceiving a causal law in terms of observed regularity, an observed event will be contingent upon the effects of several laws interacting. The critical realist positioning helped me to work with the notion that the real was more complex than my knowledge of it. "Observability may make us more confident about what we think exists but existence itself is not dependent on it" (Sayer, 2000, p. 12). Thus, though we may be able to observe some qualifications and some idea of jobs and some people moving into these jobs, it must also be acknowledged that there are structures and mechanisms which may be unobservable but that influence and shape what is real. Understanding these structures and mechanisms is what creates the opportunities for us to enable change.

According to Carter and New (2004), social and cultural structures are generative mechanisms because when their causal powers are activated, they work to make something happen. They cautioned that "mechanisms in social life never work mechanically" on their own (p. 27). Consequently, realists see social and cultural structures as having the power to be causally efficacious in that they enable some actions that would otherwise not be possible, and constrain other action (Benton & Craib, 2001; Carter & New, 2004). Thus critical realist research enables a researcher to identify causal mechanisms, understand how they work, and if they have been activated, under what conditions.

The critical realist lens also enabled the study to address what Bhaskar (1993) saw as key problems of western philosophy, namely 'ontological actualism' and the 'epistemic fallacy'. The **epistemic fallacy** emerges when epistemology is over-emphasised at the expense of ontology; it reduces being to knowledge of it (i.e. it could reduce learning pathways research to knowledge of the existing, experienced learning pathway of the learner / worker / professional). This is consistent with the 'pathways engineering' approach highlighted by learning pathways researchers (McKenzie, 2000a and McKenzie 2000b; Raffe, 2003; Vaughan, 2003; Vaughan, 2005). **Ontological actualism**, on the other hand, involves equating ontology to actual events. For social science, this means that human conduct (e.g. construction of a learning pathway) cannot be reduced to observable behaviour or social effects (as in positivist naturalism), or to interpretive action (as in

hermeneutics) (Sayer, 2000). **Ecological fallacy** involves making inferences about individuals, where variables observed at one level are applied to explanation at either a finer or broader scale (Ferber, 2010). In **methodological individualism**, only individuals have real existence and structural properties with real causal powers are marginalised.

Bhaskar (1991) argued that it is *the process of structured, causal generation* of being which is called 'necessity', and that these processes of generation operate differently in the natural and the social worlds. One could, for example, argue that the way in which the NQF system differentiates and forms structural environments producing generative mechanisms, enablers or constraints for learning pathways, will form part of the 'natural necessity' of a learning pathway. Collier (1994, p. 6) explained that depth realism, which takes account of 'necessity' stressed that knowledge may be "not only of what appears [e.g. the positive rendition of a learning pathway], but of underlying structures which endure longer than ... appearances, and generate them or make them possible". This highlights that the positive account of a learning pathway may therefore only provide partial knowledge of learning pathways, and that there is a need to examine the underlying structures that shape or generate learning pathways in particular ways.

2.3.2 Laminated systems

Understanding the complex nature of environmental learning pathways involved conceptualising the pathway as several ontologically different and irreducible levels. I tried to conceive of it as "ontological levels that cannot be separated" (Nunez, 2014, p. 111). Bhaskar and Danermark (2006) argued that conceiving of social phenomena as laminations would help researchers contend with reductionism as no one ontological level should be privileged in research. Therefore, they recommended case specific disciplinary ensembles depicting laminated totalities. Nunez (2014, p. 104) suggested that there is no a priori way in which reality produces complexity; thus the building of a laminated system does not follow a particular ordered approach; rather its formation is in direct relation to the explanatory concerns and the reality that determine them.

As presented in Chapter 1 (and deepened in Chapters 7 and 8), I have tried to understand the complexities of pathway formation by reconfiguring the Multi-Level Perspective (MLP) introduced in Chapters 1 and 2 as a laminated system for transitioning into environmental occupations.

This underlabouring enables us to explore a perspective that goes beyond the colloquial currency that the concept of learning pathways has gained in South African education policy, which has focused mainly on 'pathway engineering' which represents fairly "flat, actualist accounts ...", or a "purely positive account of reality" (Bhaskar, 1993, p. 400). The dialectical critical realist

(introduced below) perspective necessitates in-depth research and deliberation that enables us to look beneath what we see (the way a learning pathway is shaped or not shaped).

The MLP ideas resonate with critical realist propositions used in this study and outlined in section 3.4 of Chapter 3. Like MLP, critical realists conceive of the social world being a fundamentally open system. Within this open system there are no laws with uniform effects, event regularity is rejected and key actors and their environments are changing constantly.

Critical realists argue that reality is both stratified (real, actual, empirical) and differentiated; they are able to envisage structures and mechanisms operating at non-actual, but nevertheless real levels. Price (2012a) explained in her presentation that “in open systems a multiplicity of mechanisms (conditions, agencies), emergent at different layers of reality, is always involved”; it is this multiplicity that generates the complexity suggestive of open systems. Critical realist research should aim for a rich variety of perspectives of the same object; hence the need for what Bhaskar and Danermark (2006) called “laminated explanations”. This emphasises the need to examine different dimensions of a phenomena. In my study this has meant that to understand the nature of the environmental learning pathway within this transitioning system, I need to conceptualise the learning work transitions in their laminated totality (Bhaskar, 2010, pp. 9-10). This is depicted in Figure 2.4 below which illustrates how the transitioning idea has been built across the chapters to enable me to develop a deeper meaning of the transitioning processes and outcomes within environmental learning and work that shape environmental learning pathways. In the final chapter I reflect on the usefulness and alignment of the study for mega and planetary level green skill processes.

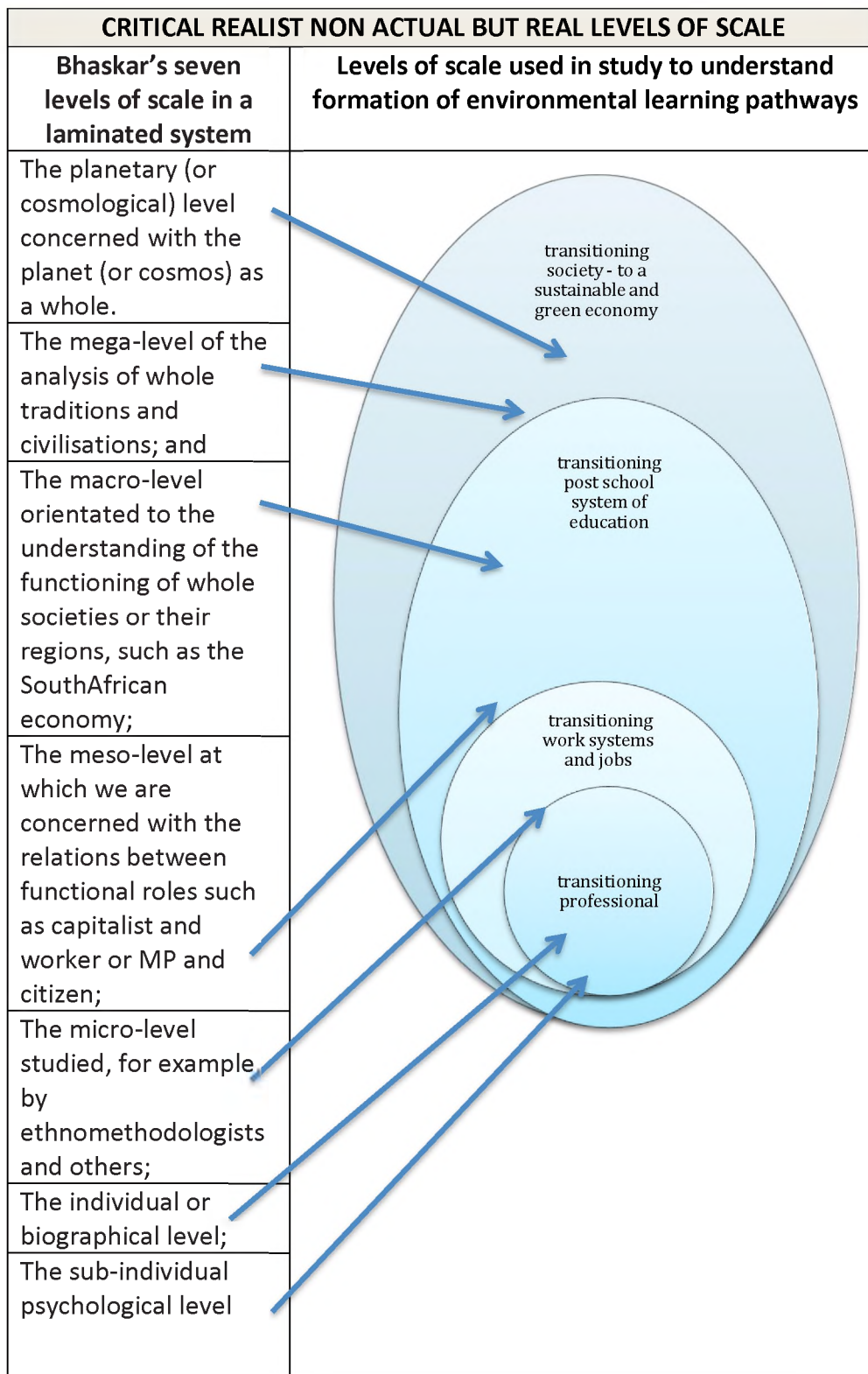


Figure 2.4: Understanding the learning and work transitions that shape environmental learning pathways as a laminated system

2.3.3 Structure and agency

The critical realist underlabouring has also helped the study deal with an important critique of the MLP as outlined by Hargreaves, Haxeltine, Longhurst and Seyfang (2011). A “common critique of the MLP is that it inadequately conceptualises actors and agency” (ibid., p. 4). The discussion in

this section outlines how structure and agency are viewed within critical realism and thus helps to illustrate how it assists in addressing Hargreaves' critique.

Educational and occupational structures do not exist independently of the actions they govern:

Societies pre-exist the human agents who live in them and are a pre-existing condition for human activity. However, the ensemble of structures, practices and conventions require human agency for their reproduction or transformation. (Joseph, 2002, p. 9)

Agency is linked to social structures, which "stand as objects of study in their own right" (Norrie, 2010, p. 10). Understanding learners' agency in constructing their learning pathways cannot be understood without an understanding of social structures, and how they shape learners' choices, and how agents in turn shape them in the NQF system. People do not necessarily work or develop learning pathways to reproduce the capitalist economy and ignore environmental conditions, yet these results are unintended outcomes of their actions (reproducing structure) and the necessary condition of their acting (grounding and enabling their agency) (ibid., p. 11). Through his Transformational Model of Social Activity (TMSA), Bhaskar gave causal primacy to structure over agents (Joseph, 2002) but this, he argued, was the basis for any transformative activity as well.

Although social structures are often reproduced automatically, smoothly (or at least unconsciously), this is not always guaranteed, particularly because different social structures interact with each other in complex structural ensembles. The fact that the reproduction of social structures or structural ensembles is not always guaranteed means that strategic interventions are both possible and often necessary. This is the point at which the dialectics of reproduction/transformation and enablement/constraint are made concrete. (Joseph, 2002, p. 10)

This study focused on investigating the pre-existing institutional pathways and the emergent individual agency led pathways into the crafting of a green job allows the development of an understanding of the structure agency interplay.

Diagram 2.4 above helps to illustrate how using MLP and critical realism together, I was able to reconfigure a multi-level framework for understanding learning pathways that work with structure and agency together. The discussion below provides further explanation of how I conceived and formulated a theoretical frame for the study.

2.4 Introduction to the relationship between meta-theory and domain specific theory in this study

Chapter 1 introduced aspects of the transitioning tale of South Africa and South Africans; this is continued in Chapter 3. Planning an environmental education research project in these transitioning times raises interesting challenges. Lotz-Sisitka (2009, p. 169) highlighted that

“change orientated learning and research needs to be located at the interface of local and global as well as past, present and future, creating not only a challenging epistemological frame but also a challenging temporal and spatial frame for such research”. The socio-ecological challenges introduced in this chapter are amplified now with the emerging drive towards a greener economy and this presents a clear responsibility for research in this region; in fact, research will have little use if it does not address some of the massive social justice and immediate livelihood consequences associated with loss of ecosystems and ecosystems services (Lotz-Sisitka, 2009). How learning and work systems respond to these emerging pressures is a central underlying interest in this study.

Shaping a conceptual and theoretical framework requires a researcher to carefully consider the context, the field of practice and the inherent research interest of their study. As an environmental education study, this research set out to investigate the nature of the environmental learning pathway that people were following/creating in these transitioning times and how the systemic pathways were enabling or constraining pathways for sustainable development, to inform transformative praxis.

In attempting to characterise the complex nature of environmental learning pathways I have utilised a mix of theoretical ideas in this study. These have enabled me to portray environmental learning pathways as **educational and occupational progressions** (Wheelahan, 2009). Using this conceptual construct, it was possible to investigate the nature of learning and work transitions across the life-course of selected environmental professionals. This enabled a more nuanced look at the formation of the career story supported with ideas from career theory, in particular boundaryless careers and the patterns of mobility people displayed in crafting boundaryless careers (see Chapter 4). To ensure that I engaged meaningfully with environmental learning pathways as complex social phenomenon within open systems, I used two conceptual schema: firstly, the multi-level perspective of transitioning to sustainable development to work with the co-evolutionary processes of systems during sustainability transitions (explained in section 2.2.) This ensured that I did not succumb to reductionist conceptualisations of learning pathways. Secondly, to reinforce this and strengthen the ontological underlabouring, I used the critical realist notion of laminated systems that allowed me to resolve a complex situation into its separate yet related and emergent components so as to identify and relate the various mechanisms as different levels of reality which enable and constrain emergence of learning pathways (Nunez, 2014).

The critical interest in the study and the inherent needs of environmental education research in this region prompted me to investigate how I could escape the 'logic of immediacy', the pervading idea that truth is known immediately (Cruickshank, 2003). A 'logic of immediacy' would focus on an actualist (event focused) ontology within the learning and work transitioning ideas, an ontological view that is found wanting in terms of its explanatory power (Cruickshank, 2003; Bhaskar, 1993; Sayer, 2000). To address this problem, this study needed to use conceptual tools that allowed for stronger engagement with a depth ontology, emergence, historicity, causality and possibilities for transformative praxis (Bhaskar, 1993; Shipway, 2011). To do this I drew on the recommendations of Price (2007), Lotz-Sisitka (2009) and Schudel (2012) who emphasised that environmental education research needs to have a stronger, wider ontological referent for its environmental, educational and social change concerns. This allowed me to reflect on the limitations of using only middle range theory (transition theory, life course, learning pathways, as discussed in Chapter 4) that would keep the study confined to the empirical contexts of the research with an ontology that is constituted by the realm of empirical events and the experience of these events with no account for underlying causes or transfactual explanations. I thus felt the need for a meta-theory to enable me to relate to the complex open systems context of environmental systems and to allow me to transcend the limitations of the middle range theory I was using (see section 2.2.1 in Chapter 2).

I opted to underlabour my study with critical realism as it offered me theoretical tools to work with the social world as a complex, open system (an idea that resonates with the multi-level perspective of transitions – refer to section 2.2). A closed system actualist ontology would imply that causal laws are defined in terms of empirical regularities as can be seen, for example, in the dominance of large scale tracer studies used in transitioning work. Through the critical realist stratified ontology of emergent properties, Bhaskar explained that causal laws exist qua emergent properties that exist in open systems (see section 2.3 for further explanation of critical realism as used in this study). According to critical realism, causal laws can interact in a number of ways in open systems, so the observed effect of causal laws are always contingent upon a particular configuration of causal laws having effects at a particular point in time (Sayer, 2000; Cruickshank, 2006). An important implication of this ontology is that powers can exist unexercised; thus what has happened or has been known to happen does not define what could happen, as explained by Sayer (2000): "... the nature of the real objects present at a given time constrains and enables what can happen but does not pre-determine what will happen ... makes it possible to understand how we could be or become many things which currently we are not" (p. 12).

The critical realist layered ontology (introduced in section 2.2) helped me to create a more accurate depiction of learning and work transitioning as a social phenomenon. Thus, in summary, in my study the empirical work and domain theory was used to demonstrate the key problems, issues and inefficiency within learning pathway transitions in my selected occupations and the metatheory helped me to develop a transfactual theory of why that is and how learning pathways for environmental skills could be re-imagined. The dialectical critical realism (Bhaskar's MELD framework outlined in section 4.5) helped me to identify absences and through this, point to opportunities for transformative praxis interventions (Bhaskar, 1993). This was necessary to support the emancipatory interest of the study.

Crafting this context within an appropriate theoretical framework led me to the work of Cruickshank (2006) who provided a useful frame for thinking about how to conceptualise levels of realist theorising. Using the Cruickshank framework, the diagram below illustrates the interplay of theoretical ideas that have framed this study. It provides a heuristic to show how metatheory and domain specific theory are interconnected in this study. The diagram below (Figure 2.5) thus shows how I utilised different middle range theory or domain specific theory as referenced by Cruickshank (2006) such as learning pathways, learning and work transitioning, job mobility in boundaryless work (all discussed further in Chapter 4), multi-level perspective on sustainability transitions. All these theories helped me to interpret and give meaning to the empirical phenomena observed and to "transcend sheer description or empirical generalisation" (Pawson, 2008, p. 2). The diagram illustrates the aspects critical realism used in the study to underlabour the middle range theory. The diagram also illustrates how I deepened the critical realist work and analysis by identifying and analysing what was absent (core role of absence) and how it could help me to identify opportunities for transformative praxis within environmental learning pathways (see section 4 and Chapter 9).

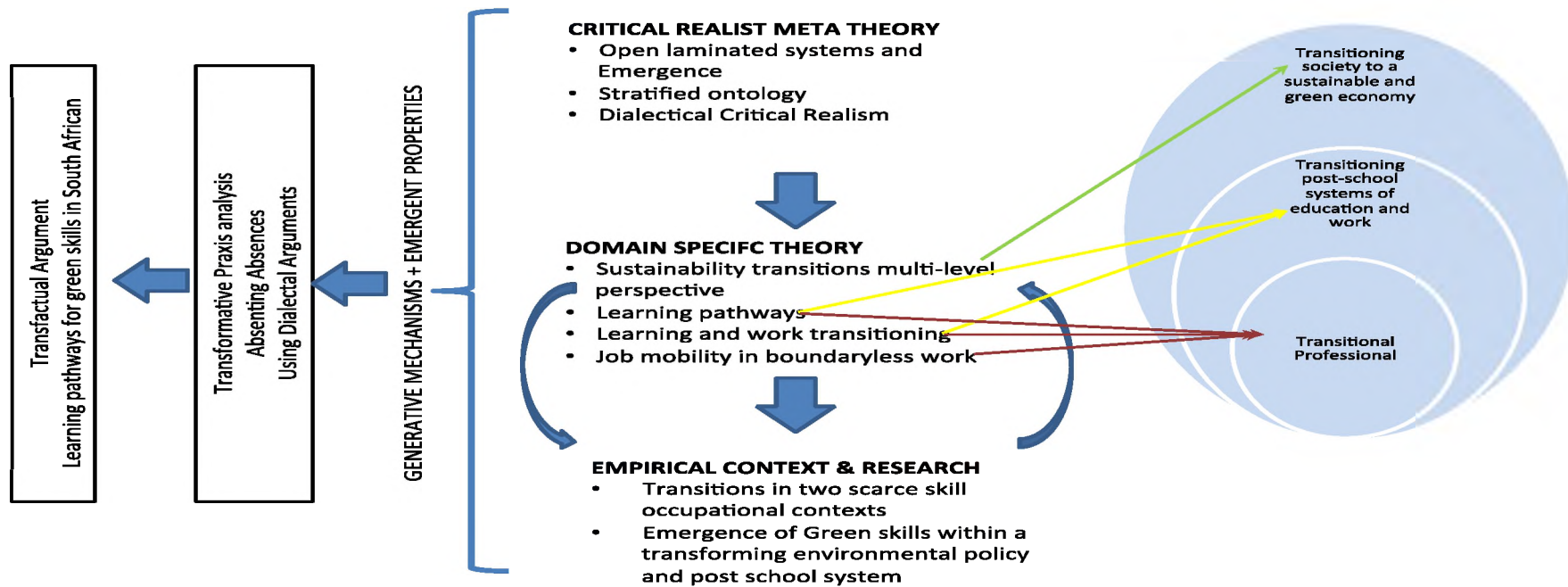


Figure 2.5: Theoretical ideas shaping this study

2.5 Conclusion

In this chapter, I have provided an orientation to the main theoretical ideas that shaped the foundation of the study. This was necessary to guide the reader to the positioning and locating of the study, designed to explore learning pathways as multi-level laminated systems. This has thus helped me to scaffold the reader to the main thesis argument that is explored across this thesis: that environmental learning pathways are constituted by dialectically interdependent planes.

Chapter 3 will explore how the transitioning socio-ecological system in South Africa has served as a driver for numerous environmental and educational policy imperatives over recent years and hence provides the essential context of the study.

CHAPTER 3: THE TALE OF TWO TRANSITIONS

While policy makers and commentators increasingly agree that a green economy is desirable from both an environmental and an economic perspective, it is less clear exactly HOW the shift to a new green economy will take place ...

Gibbs and O' Neill (2014)

3.1 Introduction

In this chapter, I introduced two key societal systems that form part of the macro landscape – the transitioning environmental regulatory and policy system and the transitioning education and training system. Both these systems are undergoing rapid and ongoing transitions while operating within a rapidly changing society. The chapter thus narrates a tale of two transitions that form an important part of understanding the landscape pressures introduced in section 2.2.

The tale of the environmental system unfolds how environmental approaches have evolved for the preservation, species conservation orientations towards a more co-operative governance approach and most recently, the rapid and all-encompassing green growth, green economy discourse. The tale of the educational and training system recounts the change from apartheid education to managing a more integrated reformed education and training system. The chapter then presents an overview of the post-school system, and the transitioning skills development systems, which will form the basis for the discussion in Chapter 6.

3.2 A tale of two transitions

This section outlines the story of two unfolding transitions in South Africa, both of which are central to this thesis: firstly, the tale of the transitioning environmental regulatory framework, and secondly, the tale of the transitioning education and training system. This tale is further contextualised with the transitioning society introduced in Chapter 1.

3.2.1 A transitioning environmental system

3.2.1.1 A transitioning environmental policy and regulatory framework

In South Africa environmental performance must be viewed in the context of the transition from apartheid. Historically the approach to ecological concerns pre-1980 was fragmented and conservative reflecting the interests of the privileged white sector of South African society (Ramsarup, 2005). Government and non-government organisations were largely concerned with establishing and maintaining nature parks and saving endangered species, such as the rhinoceros.

Little attention was paid to the negative impact of conservation programmes on poor blacks living in the affected areas. Thus, pre-1980 the dominant discourse was predominantly conservation orientated, with a strong intent to preserve and conserve species, and with little recognition of people and their needs. Significant was the complete absence of social justice in the environmental discourse of the time. This booming conservation movement was further developed into a trend later known as 'earth love education'. This represented a spiritualising turn in conservation education closely linked to the prevailing educational ideology of the time (Ramsarup, 2005; Ramsarup & Lotz-Sisitka, 2013). Under apartheid, environmental policy had two key characteristics: there existed an extensive regulatory framework for nature and conservation, and at the same time there were very few provisions for linking economic and environmental policies. The landscape was characterised by wide variations in the regulatory enforcement across the country (OECD, 2013).

The early 1990s marked a period of radical political change in South Africa. This was followed by a shift, in the early 1990s, to a more people-centred, participatory approach to ecological concerns. 'Green politics', which sees people and environment as intimately connected, became a central feature of the emerging politics (Ramphela, 1991, p. 7). Key documents emergent at the time depicted the rise of environmental issues on the country's agenda. For example, the ANC Environmental Policy, stated that the "citizens of South Africa, present and future, have the right to a safe and healthy environment, and to a life of well-being" (Ramsarup, 2005). The guiding principles of the ANC policy at that time stated that the ANC subscribed to the following:

- the principle of sustainable development;
- equitable access to resources;
- public participation in planning, development and management of resources;
- an integrated approach to environmental issues that relates to all sectors of society;
- public right of access to information and the courts on issues of environmental concern (ibid.).

In 1994 the Reconstruction and Development Programme (RDP) of the ANC outlined their commitment to environmental issues by committing the new democratic government to "ensure that all South African citizens, present and future have the right to a decent quality of life through sustainable use of resources" (African National Congress [ANC], 1994, p. 40). In reflecting on the RDP in 2005 I noted that it highlighted several strategies to illustrate how the fledgling democracy was going to engage with the environment (Ramsarup, 2005). The RDP highlighted policy revision;

new legislation; rethinking of development strategies; more focus on community participation in environmental decision-making and “environmental education programmes to rekindle our people’s love for the land, to increase environmental consciousness amongst youth, to coordinate environmental education with education policy at all levels and to empower communities to act on environmental issues” (ANC, 1994, p. 40).

These ideas laid the foundation for the South African Constitution, which was adopted in 1996. It linked environmental issues to human rights and social responsibilities. Giving recognition to every citizen’s right to an environment that is not detrimental to their health or well-being, the Constitution therefore signalled a national commitment to environmental action as stated in the Bill of Rights in the new Constitution, Chapter Two, section 24:

Everyone has the right:

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

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

(South Africa, 1996, p. 11)

Internationally, Agenda 21, as the action programme for sustainable development, was developed in 1992 in Rio de Janeiro. Agenda 21 marked a very significant trend: by up-fronting the focus on sustainable development, it shifted the global environmental discourse from focusing on single issues to acknowledging the complex interconnections between a whole range of environmental and developmental factors. Hence some have referred to it as the policy that initiated ‘transition to sustainability’ (National Research Council, 2002).

Against this backdrop, post-apartheid South Africa set up its ‘democracy in environment’ (Manale, n.d.) through the Consultative National Environmental Policy process (CONNEP), which was launched in 1995. The CONNEP process, which served as an umbrella participatory policymaking process, was arguably one of the “most open and accessible policy-making initiatives that the new government has undertaken” (McDonald, n.d., p. 6). The CONNEP process culminated in the promulgation of the National Environmental Management Act (NEMA) in 1998, which is the country’s primary environmental legislation (Manale, n.d.).

It is important to consider the hierarchy of environmental legislation that governs the legislative framework captured in Figure 3.1. The discussion below, as well as Figure 3.2 and Table 3.1, represent elements of this legislative framework. Figure 3.2 illustrates more clearly how sectoral

policy emerges from national legislation.



Figure 3.1: Hierarchy of environmental legislation

Central to NEMA is the concept of cooperative environmental governance. NEMA places people and their needs (physical, psychological, developmental, cultural and social) at the forefront of environmental management. It established the concepts of participatory, co-operative, and developmental governance as all integral to sustainable development. Following the release of NEMA, which formed a consolidated legislative framework, a new suite of legislation, “specialised legislation to tackle particular resource issues such as biodiversity and air quality”, emerged (Fakir, Stephens, Tholin, & Kapelus, 2005, p. 8). Figure 3.2 that follows illustrates the South Africa Framework of Environmental Legislation that emanated from NEMA (Fakir et al., 2005; Van der Linde & Feris, 2010; Raven & Rosenberg, 2011). South Africa’s commitment to Agenda 21 has been enshrined in NEMA (South Africa, 1999).

NEMA (South Africa, 1999) introduced instruments based on the precautionary principle and the polluter pays principle. It provides principles for decision-making, which must be used by all organs of state; it also outlines the institutions that will promote co-operative governance and describes the procedures for co-ordinating environmental functions within government. As such it provides the framework for environmental legislation.



Figure 3.2: Overview of national environmental legislation

- National Forest Act 84 of 1998
- National Veld and Forest Fire Act 101 1998
- National Water Act 36 of 1998
- Water Services Act 108 of 1997
- Conservation of Agricultural Resources Act 43 of 1983
- Genetically Modified Organisms Act 15 of 1997
- Animal Protection Act 71 of 1962
- Sea Birds and Seals Protection Act 46 of 1973
- Societies for the Prevention of Cruelty to Animals Act 169 of 1993
- Animal Identification Act 2 of 2002
- Animal Improvement Act 6 of 2002
- Marine Living Resources Act 18 1998
- Marine Pollution (intervention) Act 64 of 1987
- Marine Pollution (Prevention of Pollution from Ships) Act 2 of 1986
- Marine Pollution (Control and Civil Liability) Act 6 of 1981
- Mineral and Petroleum resources Development Act 28 of 2002
- Nuclear Energy Act 46 of 1999
- Nuclear Regulator Act 47 of 1999
- Atmospheric Pollution Prevention Act 45 of 1965

South Africa's hosting of the World Summit for Sustainable Development (WSSD) in 2002 further catalysed the sustainable development agenda in the country. The WSSD marked the launch of three significant documents:

- Johannesburg Plan of Implementation (JPOI);
- Johannesburg Declaration on Sustainable Development, which was a political statement by heads of state; and
- An extensive list of partnerships among government international organisations, private sector, educational entities, civil society regarding sustainable development.

Following WSSD, in July 2002, the South African cabinet adopted the National Framework for Sustainable Development (NFSD). The purpose of this framework was to enunciate South Africa's national vision for sustainable development and indicate strategic interventions to re-orientate South Africa's development path in a more sustainable direction. The strategic interventions required to achieve the nation's vision for sustainable development are grouped into five critical pathways (see box below). These pathways constitute the strategic focus areas for action and interventions that are necessary to reach the national ideal as described in the national vision for sustainable development. They reflect a systemic and integrative approach and seek to transcend traditional divisions and sectors.

Pathways to sustainable development (from NFSD, South Africa DEA, 2008)

- Enhancing systems for integrated planning and implementation
- Sustaining our ecosystems and using natural resources sustainably
- Investing in sustainable economic development and infrastructure
- Creating sustainable human settlements
- Responding appropriately to emerging human development, economic and environmental challenges.

The OECD Environmental Performance review (OECD, 2013) claimed that despite the very wide consultation during the development of the National Framework for Sustainable Development (South Africa, Department of Environmental Affairs & Tourism [DEAT], 2008), it never received adequate government support. Its completion missed the 2005 deadline set by Johannesburg Plan of Implementation and its eventual launch as a framework rather than a strategy also alluded to this lack of wide support across government departments. According to the report there were two reasons for this scenario. Firstly, the launch of Accelerated and Shared Growth-South Africa

(ASGISA), which preceded the launch of NFSD, was issued by the president and enjoyed far more visibility and support. Secondly, the DEA's leadership in NFSD process contributed to a general governmental misconception that "sustainable development is an environmental issue that happens in parallel within development initiatives in other sectors" (OECD, 2013, p. 58).

In 2011, prior to Rio +20, a five-year National Strategy for Sustainable Development (NSSD-1) was adopted. NSSD-1 is a comprehensive environmental policy covering institutions vertically and horizontally and outlining their long-term and short-term sustainable development needs. The NSSD-1 has five key priorities that are illustrated in Figure 3.3 below. The centre of the diagram illustrates an understanding of sustainability as the overall goal of the policy that directly connects healthy ecosystems and human well-being; South Africa is committed to achieving social and economic goals without compromising the natural system. Finance, Technology, Trade and Capacity Building are four central mechanisms that are needed to achieve a sustainable society. These four mechanisms have also influenced the shaping of South Africa's green economy priorities.

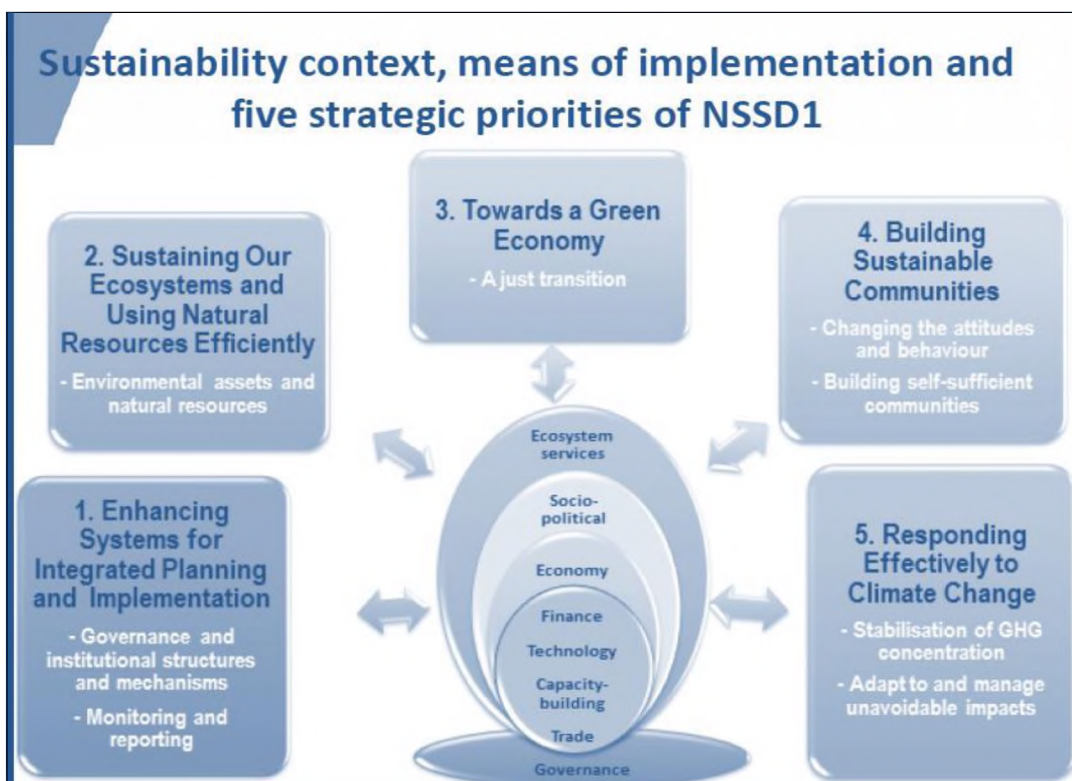


Figure 3.3: Strategic priorities of National Sustainable Development Strategy (Badul, 2013)

From this it can be seen that international policy processes also impact on national policies. South Africa remains a signatory to many international agreements, and uptakes into the national

regulatory systems are ongoing. Table 3.1 below provides a snapshot of some of the legislation South Africa has ratified. Developing this table helped me to connect the transitioning processes in South Africa to the broader international policy discourse. As we explore transitioning environmental systems it is also significant to understand the hierarchy of environmental legislation as this legislation forms a critical part of the landscape pressures introduced in section 2.2.

Table 3.1: South African responses to international environmental agreements
(Developed from discussion by Van der Linde & Feris, 2010)

Multilateral Environmental Agreement	Status	Enabling South African Legislation
United Nations Framework Convention on Climate Change 1992	Ratified 1997	NEM: Air Quality Act 39 of 2004
Kyoto Protocol 1997	Acceded 2002	No enabling legislation
Convention on Biological Diversity	Ratified 1995	NEM: Biodiversity Act 10 of 2004
United Nations Convention to Combat Desertification	Ratified 1997	NEM: Biodiversity Act 10 of 2004
Convention on the Conservation and Management of Fishery Resources in the South East Atlantic Ocean	Signed 2001	No enabling legislation
Vienna Convention for the Protection of the Ozone Layer 1985	Ratified 1995	No enabling legislation
Convention on International Trade in Endangered Species of Wild Life and Fauna 1973	Ratified 1975	No enabling legislation; relies on provincial conservation ordinances
Convention to Combat Desertification 1994	Ratified 1997	No specific legislation – national action plan
Ramsar Convention on Wetlands of International Importance	Ratified 1975	NEM: Biodiversity Act 2004

The table helps to illustrate that South African environmental policies have strengthened significantly after apartheid. As outlined by the OECD Environmental Performance Review, South

Africa has a pioneering set of laws and policies. Legal provisions on access to environmental information is in line with the Aarhus Convention, there is public participation in environmental decision making, and access to courts is comparable to OECD countries.

3.2.1.2 Challenges in the unfolding environmental transition

The discussion above has highlighted that after apartheid, South Africa developed a comprehensive policy and regulatory framework. In some areas, like biodiversity, South Africa has pioneering laws and policies that are better than in most OECD countries (OECD, 2013). However, despite an evolving policy landscape South Africa suffers from significant implementation challenges, key amongst these being fragmentation and capacity and skills deficits.

Post-apartheid South Africa embarked on an ambitious decentralisation programme to enable the functional expansion of municipalities. Kotze (2005), Paterson and Kotze (2009) and OECD (2013) have all addressed the key challenge of fragmentation: structural fragmentation which they characterise as vertical (between the different spheres of government – national, provincial, local²) and horizontal (the line functions in each sphere) as represented in Figure 3.4 below which illustrates this distribution of environmental responsibility.

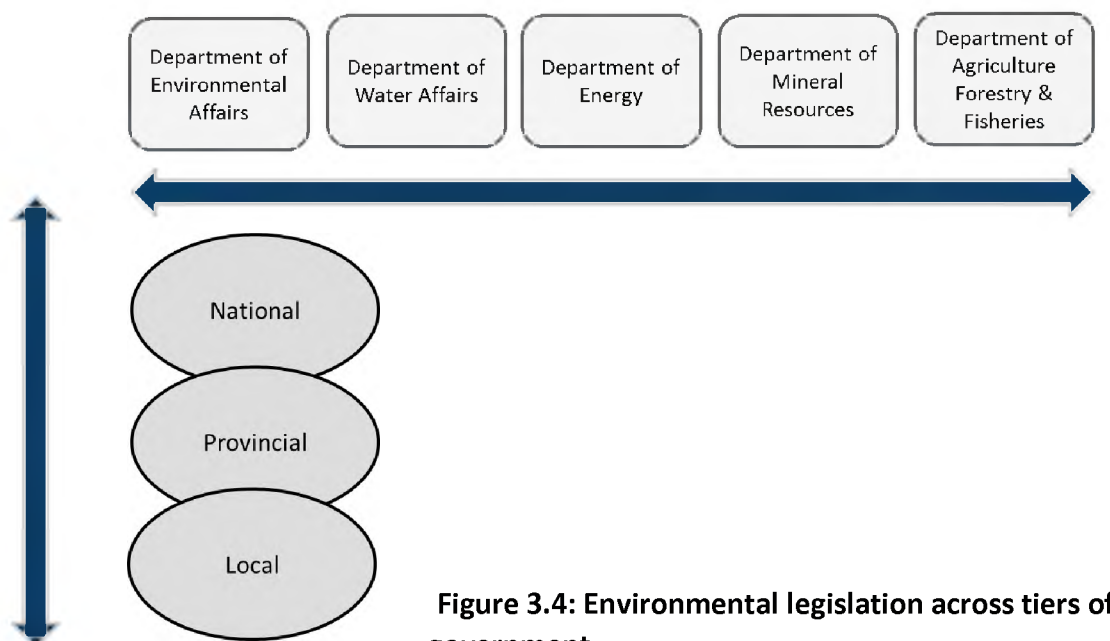


Figure 3.4: Environmental legislation across tiers of government

² The Constitution outlines three spheres of government in South Africa: National government, Provincial government and Local government. The spheres of government are autonomous and should not be seen as hierarchical. They are according to the Constitution distinctive, interrelated and inter-dependent.

Environmental departments are typically scattered across government (as shown in Figure 3.4 above, redrawn from Middleton, Goldblatt, Jakoet, & Palmer, 2011) in accordance with the environmental sector they are mandated to regulate. Further horizontal complexity is the result of each province designing their institutional framework for environmental responsibility differently. So, for example, one province may locate conservation with agriculture while another may locate conservation with environmental management and planning.

Kotze (2005), as well as Paterson and Kotze (2009), noted that environmental legislation is also fragmented: silo-based and based on environmental media. This legislative fragmentation is further compounded by inter-sectoral fragmentation which highlights the need to integrate better biodiversity concerns in other sectoral policies (e.g. in mining, energy, transport and coastal zone management). South Africa suffers from a fragmented compliance and enforcement regime: Paterson and Kotze (2009) noted the absence of an effective central environmental lead agent and argued further that the Department of Environmental Affairs fails to act as a strong, centralised lead agent (like, for example, the Environmental Protection Agency in America). What South Africa therefore has is a matrix of fragmented environmental governance institutions.

Although resources allocated to national and provincial environmental authorities have strengthened, this remains inadequate as insufficient resources (both human and financial) are allocated to provincial and local government. These levels suffer from limited qualified staff and a lack of training for current staff. According to the Environmental Sector Skills Plan (ESSP) (South Africa. DEA, 2010a), the local government sector is severely understaffed regarding environment related skills and a national initiative is urgently needed to strengthen environmental skills in the local government sector. The skills challenges can be illustrated from the data below drawn from Sector Skills Plans of the Local Government SETA. The data clearly illustrates the point above that skills deficiencies are severely hampering implementation of legislation.

Table 3.2: Environmental Scarce Skills Lists assessing scarcity complexity from LG SETA
(Based on LG SETA data 2009, 2013)

2009 absolute scarcity	2013 absolute scarcity
100 environmental managers	50 environmental managers
600 environmental engineers (particularly for water, waste and sanitation management)	30 environmental research scientists
350 environmental health technical staff and	80 environmental engineers
350 earth and atmospheric technicians (for water and air quality monitoring)	180 civil engineering technologists (environmental technologist)
300 civil engineering technicians (for water and waste management)	40 environmental planners
500 urban and regional planners (with urban, transport planning skills)	50 conservation officers
50 town planning technicians (with GIS skills)	15 environmental science technicians
200 water plant operators (due to new legislation)	180 recycling or rubbish collectors

At local government level, funding, skills and capacity remain under severe pressure and are central to why some municipalities fail to cover the delivery of core environmental functions (Middleton, Goldblatt, Jakoet, & Palmer, 2011). The vast discrepancies reflected in the data above could furthermore illustrate that data emerging from skills authorities is largely indicative and it raises concern on the accuracy of demand side analysis work for environmental jobs.

3.2.1.3 *The emergence of a green economy*

The social and economic policy context outlined in Chapter 1 describes the background to the transition to a green economy. In this section, I explore some key dynamics of this emerging new discourse in South Africa to illustrate the latest developments in this transitioning tale.

Twenty years after the green economy first appeared in the *Blueprint for a Green Economy* (Pearce, Markandya, & Barbier, 1989), support and interest is intensifying both globally and locally. This has been mostly as a result of the 2008 financial crisis and the interlinked energy and food crisis. This could illustrate that the support for the green economy was promoted largely by the market rather than environmental policy (ILO, 2010). The United Nations Environment Programme (UNEP) proposed a Global Green New Deal in 2009 as a viable option for moving national economies out of the crisis. The proposal was seen as a multi-pronged development paradigm that incorporated three concrete objectives:

- Economic recovery;
- Poverty reduction; and

- Reduced carbon emissions and ecosystem degradation (UNEP, 2009).

Following this Global Green New Deal, UNEP published the Green Economy Report in 2011. This document gave countries a comprehensive orientation to sector analysis and recommendations for change. In South Africa, the interest and growth trajectory has been fairly rapid. The Green Economy Summit was held in South Africa in 2010 and was jointly hosted by four government departments. The summit laid the foundation for a collaborative approach to the unfolding green economy strategy. Within South Africa, it was a fortuitous time to garner support for the transition as the New Growth Path had set a goal of five million jobs by 2020. The green economy has come to be seen as a new driver of the country's sustainable development agenda. Transition to a green economy offers the opportunity to create up to 300 000 jobs (see Table 3.3 below). The Green Accord (2011), which is Accord 4 of the New Growth Path, outlines the joint commitment by government, trade unions, and business to the green economy.

Figure 3.5 below illustrates the national framework that supports the green economy and helps to illustrate the progress depicted by the mainstreaming of environment into core economic policies as an intricate part of economic development. The green economy, it can be seen, is identified as one of the ten job drivers identified by the New Growth Path.



Figure 3.5: National framework supporting green economy
(Adapted from Badul, 2013)

Lotz-Sisitka et al. (2013) elaborated on the need to plan for a strong coordinating body for green skills in the face of current fragmentation of mandates and complex interconnections. Drawing from the transition processes outlined earlier in the chapter, enabling regime change in the transition to a green economy will involve multi-domain and multi-actor processes.

The extract below, drawn from a report produced by the Trade and Industry Policy Strategies (TIPS) entitled *Green Economy Policy Framework and Employment Opportunity: A South African case study*, helps to illustrate the scope of the co-ordination required for a green economy:

The National Strategy for Sustainable Development and Action Plan (NSSD) is the responsibility of the Department of Environmental Affairs (DEA), but the National Planning Commission (NPC), a department of sustainable development in all but name, resides in the Presidency (it however has advisory powers only). The Economic Development Department (EDD) includes the green economy under its formulation of a New Growth Path (NGP) for the country, but EDD only has direct control over the two main state-run development finance institutions: the Development Bank of Southern Africa (DBSA) and the Industrial Development Corporation (IDC). Support for green industry falls under the Department of Trade and Industry (DTI), but the DTI has to rely on other departments to implement measures aimed at green industries. Environmental fiscal reform (green taxes and subsidies which supports both green industries and the greening of the economy as a whole) is under the mandate of the National Treasury (NT). The DEA is responsible for the protection and restoration of ecosystems and the setting of environmental standards (e.g. for pollution or emissions). The Department of Energy (DoE) is in charge of issues relating to fossil fuels and renewable energy. The Department of Water Affairs (which falls under the same ministry as the DEA) is responsible for issues relating to water, and technology policy and research and development (R&D) are under the Department of Science and Technology (DST). Other departments (including for mining, agriculture, forestry, fisheries, transport, housing and local government) all contribute to green economy activities and thereby to green jobs at the sectoral level. (Montmasson-Clair, 2012, p. 6)

The long extract above helps to illustrate that the responsibility and coordination of the green economy is comprehensively and inherently co-operative and involves a wide range of government departments and agencies. Central to the transition are enabling policies and institutions to support the transition to a green economy. The envisaged transition is an ambitious one and will require a comprehensive policy mix. In South Africa there are a wide range of policy documents that are linked to the essential support of a green economy, represented in Figure 3.6 below.

Policy Documents linked to Green Economy



Figure 3.6: Policies related to the green economy (Adapted from UNEP, 2013)

The meeting of African ministers in Ethiopia prior to Rio+20 acknowledged that market mechanisms were not sufficient for rapid economic transformation. They agreed that such transformation is contingent on planning, formulation and implementation of appropriate development plans and policies. The meeting outlined six areas for green economy policy-making, including:

- Promoting investment and spending in areas that stimulate a green economy;
- Addressing environmental externalities and market failures;
- Limiting government spending in areas that deplete natural capital;

- Establishing sound regulatory frameworks;
- Investing in capacity building and training; and
- Strengthening international governance. (United Nations Economic and Social Council, Economic Commission for Africa, 2011 p. 20)

Overcoming the critical challenge of unemployment illustrated in Chapter 1, is core to the development of the country and transitioning to a more sustainable society. Promotion of income generating activities that foster new forms of economic activity is essential. Chapter 1 introduced the job growth potential of the green economy as described by the DBSA research (Maia et al., 2011). Table 3.3 below provides a more detailed picture of current and potential employment in the main South African green economy sectors by 2025.

Table 3.3: Projections for Green Jobs

Sectors	Current employment	Potential additional employment (by 2025)
Waste management (including recycling)	36 960-131 130 jobs (90% unskilled), including 40 000 in plastic recycling, 10 000 in scrap metal, 35 000 in metal beverage cans (DTI, 2009)	165 134-351 314 jobs (90% unskilled labour) (DTI, 2009) but only around 16 000 direct jobs (Maia et al., 2011)
Biodiversity and natural resource management	73 392 biodiversity-specific personnel but 1 158 264 jobs in biodiversity-related sectors (Vass et al., 2009; SANBI and the Lewis Foundation, 2010) 23 000 full-time equivalent/person-years employment to low-skilled workers in ecosystems restoration with the Working for Water programme (Peter et al., 2010)	110 000 additional full-time equivalent per person-years employment with the Working for Water programme (Maia, et al., 2011) As much as 350 000 person-years in soil and land management through payment for ecosystem services (Blignaut et al., 2008)
Sustainable/public transport	Unknown	41 642 jobs in bus rapid transit in the long term (mostly in operations and maintenance after the decline of construction work) (Maia et al., 2011) and 148 000 with the Gauteng mass rapid transit railway and bus system (Gautrain) (Naidoo, 2009)
Wind energy	Negligible	5 000 jobs in long term (Maia et al., 2011)
Solar energy	Very low	Minimum of 16 500 direct jobs (13 500 in photovoltaic and 3 000 in concentrated solar power) including 9 000 in manufacturing (Maia et al., 2011)
Waste-to-energy	Unknown	37 000 direct jobs in the biomass industry, 10 000 in cogeneration and 7 000 in landfill gas, anaerobic digestion and pyrolysis/gasification (all essentially in operations and maintenance (Maia et al., 2011)
Biofuels (bioethanol and biodiesel)	Unknown	More than 50 000 direct jobs, mostly from the growing of crops for raw material supply (Maia et al., 2011)
Building and housing energy efficiency	Limited	6 500 direct jobs in building, construction and installation (Maia, et al., 2011)
Solar water heating	Approximately 700 people (including 200 in manufacturing and 400 in installation) (Maia et al., 2011)	17 620 new direct jobs, 16 278 of which in installation and 1 225 in manufacturing (Maia et al., 2011)
Electric vehicles and lithium-ion batteries	Less than 100 people	10 000 in manufacturing (production of electric cars and buses, and of lithium-ion batteries) conditional to government support (Maia et al., 2011)

Sources: Based on the DTI (2009); Maia et al. (2011); Vass et al. (2009); SANBI and The Lewis Foundation (2010); Peter et al. (2010); Blignaut et al. (2008) and Naidoo (2009) as cited in TIPS Report (Montmasson-Clair, 2012).

Table 3.3 illustrates that the green economy has implications for many sectors of the economy. It also gives us an illustrative idea of the size and scope of this emerging sector: it is larger than the mining sector in South Africa (Lotz-Sisitka et al., 2013). When thinking about the green job potential, it is important to explain that not all green jobs will be new jobs; some will involve 're-skilling' or changing work practices as new green skills are introduced into existing jobs. Some countries e.g. the USA are calling them 'derivative jobs', jobs that are being derived from existing ones and are involving a skill specialisation. Section 6.2 discusses the conceptual framing of green skills more elaborately.

The discussion above has illustrated the growing momentum and support for a green development path. In the contexts of social inequality, unemployment and ecological degradation as outlined in Chapter 1, it is also important to explore some of the varied contestations surrounding this emerging discourse.

Sociologist Jaclyn Cock (2012) has cautioned "the 'green economy' is an empty signifier... everything depends on who claims it and gets to fill it with meaning" (p. 1). Drawing on Wallis (2010), Cock emphasised that the environmental crisis "is a crisis arising from and the perpetuated by the rule of capital and hence incapable of resolution within the capitalist framework" (Cock, 2012, p. 1). She claims that capital is appropriating the climate crisis and promoting the further commodification and even financialisation of nature in the form of the 'green economy'.

In a similar vein, Gibbs and O'Neill (2014) have argued that the all-pervading UNEP definitions of green economy as well as the Global Green Deal, perpetuate business as usual, neoliberal economics and growth and reliance on technology, rather than promoting a real paradigm shift that focuses on holistic integration of social and environmental sustainability. They further argued that although this 'current greening' approach to growth and economics is green tinged, without constraints on consumption and demand we shall remain trapped in consumptive economies.

In supporting her thesis that the green economy discourse is a "wolf in sheep's clothing, the 'wolf' being green neo-liberal capitalism", which resonates with the Gibbs and O'Neill argument above, Cock (2012, p. 2) raised two critiques that are useful to this thesis: she argued that the emerging green discourse does not sufficiently engage with working class and justice issues, thus the evolving notions of justice are neglected or naïve. A second critique is that the creation of green jobs is being viewed as something distinct and as an add-on to the 'real economy'. This, she argued, represents a compartmentalisation of the green economy discourse. Adding his critical

voice to support the arguments put forward by Cock, Death (2014) described the dominant green economy discourse in South Africa as a 'green growth' discourse. Green growth discourses present "green markets as an economic opportunity" (Death, 2014, p. 7) and the Green Economy Accord presents four principles – opportunity, innovation, responsibility and partnership. Opportunity and innovation are the first two, which is also indicative of the green growth intent. Thus there is a growing community of critique outlining South Africa's emergent green economy response as promoting technological innovation and new markets and hence not addressing core concerns of social and environmental justice (Cock, 2012; Death, 2014).

Drawing on these critiques will be critical in the focus on core economic sectors and the design of supportive legal and fiscal policies for greening those sectors. It is also important not to neglect the role of education and training, as essential building blocks for the transition to a green economy. This will involve green skilling, creating public participation as well as public awareness. This raises the importance of education system responsiveness. The section below tries to lay the foundation for how the South African education system has started to respond to the emerging green discourses, processes which too are not without their problems when seen from a social justice and emancipatory view.

The discussion in this section has explained the transitional tale of South Africa's environmental framing, policy, governance practice and its emerging transition to a green economy discourse. Figure 3.7 summarises this unfolding transitional tale. The section that follows below will explore how the transitioning education and training system has responded and appropriated the environmental discourse.

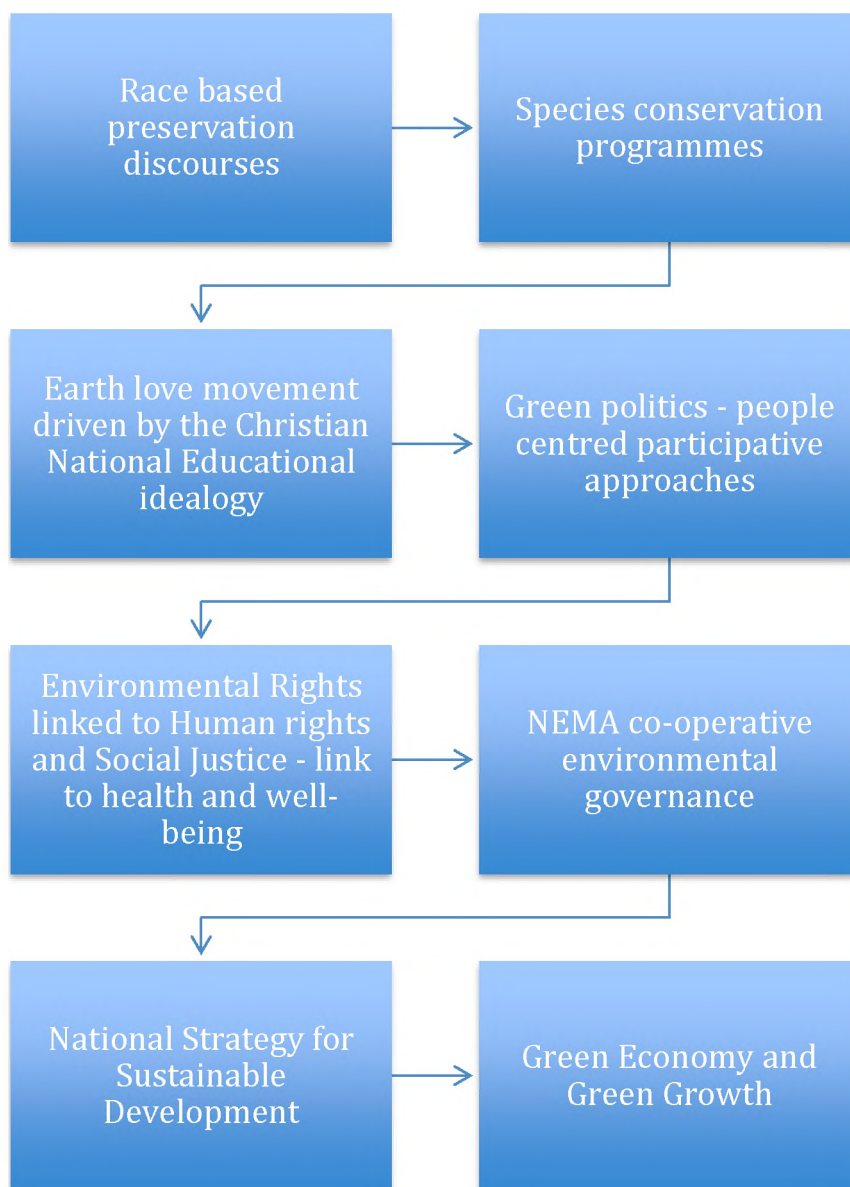


Figure 3.7: Summary of transitioning environmental tale

3.2.2 The transitioning education and training system

3.2.2.1 Transitioning legislation and policy framework for education and training

The discussion below provides a chronological overview of the legislative and policy frameworks that frame the transition of the education and training system in South Africa.

The legacy of apartheid education is central to any discussion on educational transition in South Africa as the apartheid government used education as a key mechanism to segregate racial groups as noted below.

Education policy was central to apartheid. Education was used to reinforce lack of democracy, as well as social and economic inequality, by destroying and denying access to education; by providing poor quality education to most black people; and by controlling

the content of syllabuses to reflect the interests of the apartheid state ... there were thus 18 separate education departments, leading to a system which was fragmented and inefficient, as well as being characterised by extreme inequality and inefficiency. There was a discriminatory hierarchy of financing, resources, facilities, and quality. (Allais, 2010, p. 6)

Denying black people access to education enabled the architects of apartheid to accomplish the most significant and long-term disempowerment of black people (National Skills Development Handbook, 2010). Post-apartheid educational reform was very strongly driven by the labour movement. Wedekind (2013) highlighted that labour concerns were twofold in the transition to democracy: firstly, avoid redundancies that were an inevitable consequence of reintegration into a global economy by upskilling workforce to improve competitiveness and productivity, and secondly, recognise prior learning to credit those that had acquired skills informally. The National Qualifications Framework (NQF) became a symbol of the transforming state of education and the vehicle that would integrate education and training. The South African NQF has been seen internationally as “one of the most, if not *the* most, ambitious qualifications frameworks’ (Allais, 2010, p. 1). Arising from discussions and negotiations with unions, the underpinning vision of the South African NQF was to deal with the apartheid legacies of job reservation and retrogressive and discriminatory training practices by creating ladders of opportunity, or learning and career pathways (South Africa. Department of Education [DoE] & Department of Labour [DoL], 2003).

1995 also saw the promulgation of the South African Qualifications Act (SAQA) as the first education and training legislation of the new post-apartheid parliament. Through this Act the NQF came into being with SAQA being established to oversee the NQF (Allais, 2010, p. 11). The adoption of the NQF marked the coming together of education and training into a single, integrated, coherent and unified system. Raffe (2005) explained that an integrated qualifications framework “is one that recognises and celebrates a wide range of purposes, epistemologies, modes and contexts of learning but which also recognises the need to build these into a coherent and coordinated system” (presentation at NQF conference). NQF stakeholders in South Africa have had to actively engage with the concept of integration in the absence of direction (Allais, 2010). Isaacs (in South Africa. DoE & DoL, 2002, p. 67) noted that “for some, [an integrated framework] is actually an integrated system. For others, it is two systems running side by side and if you occasionally look over the fence dividing the two, that's the integrated approach”. Muller (2000, p. 96) noted that there was the expectation of the NQF to generate coherence “through a wide variety of mechanisms and a multiple delivery system”. In the primary drive for the development

of an integrated education and training system, the focus in vocational education primarily was on institutional size and shape, rather than curriculum.

Raffe (2009), drawing on Allais' (2007) typology, characterised the South African NQF as a 'transformational' NQF which he explained "takes a proposed future system as its starting point and defines the qualifications it would like to see in a transformed system, without explicit reference to existing provision. It typically uses learning outcomes for this purpose because they allow qualifications to be specified independently of existing standards, institutions and programmes" (p. 5). In describing the extensive multi-stakeholder negotiations behind the NQF, Allais (2010) explained that "a system which focused on outputs was argued to meet both the economic and social needs of the country and the development needs of the individual ... a national framework of learning outcomes, compiled into qualifications and part qualifications" (Allais, 2010, p. 10). Learning outcomes, against which learning would be "delivered, assessed, quality assured and certified" were largely defined by stakeholders outside of educational institutions, and became a central mechanism of educational reform. This had the significant implication that qualification development would be independent of educational institutions who would use/choose 'their own content or knowledge' to achieve learning outcomes (Buchler, 2012). This was an attempt to democratise education, as stakeholders would have a key say in standards. Furthermore, it removed the power of defining knowledge and skills from formal institutions only and provided an opportunity for industry to play a greater role in defining standards.

As a crucial instrument of the national high-quality integrated education and training system that democratic South Africa aspired to create (South Africa. DoE & DoL, 2002), the stated objectives of the NQF are expected to:

- Facilitate access to education and training;
- Facilitate mobility and progression within education, training and career paths;
- Enhance quality of education and training;
- Accelerate the redress of past unfair discrimination in education, training and employment opportunities;
- Contribute to the full personal development of each learner and the social and economic development of the nation at large. (South Africa. DoE & DoL, 2003; ILO, 2010; Prinsloo, n.d)

These NQF objectives entrenched the principles of access, progression, articulation, and mobility and laid the foundation for the integrated education and training system. There are thirteen fundamental principles underpinning the NQF. The principles echo the idea that the NQF is a way of fundamentally restructuring education and training systems. I will now discuss the principles of access and progression, as they are central to this thesis.

The NQF principle of access aims “to provide ease of entry to appropriate levels of education and training for all prospective learners in a manner which facilitates progression” (National Skills Development Handbook, 2010, p. 75). Access to education is an entrenched right in the Constitution (South Africa, 1996) as well as the Freedom Charter³.

In South Africa 3 200 000 young people in 2010 did not gain access into post-school education (Cloete & Butler-Adam, 2012). According to Cloete and Butler-Adam (2012), there are two and half times the number of people out of education as there are in education within the 18-25 year-old cohorts. For educators, and the education and training system more broadly, this reality poses critical questions around delivery on the NQF principles of access, progression, articulation and mobility, which lie at the heart of an integrated education and training system. The principle of progression, which is central to a study on learning pathways, aims “to ensure that the framework of qualifications permits individuals to move through the levels of national qualifications via different combinations of learning programmes” (National Skills Development Handbook, 2010 p74). Often linked to progression is the idea of ‘seamlessness’, which espouses the vision that education and training need to be flexible in how learning ends are achieved but also flexible in allowing learners to progress on the NQF through more than one combination of completed learning programmes (National Skills Development Handbook, 2010).

Recently the Department of Higher Education and Training highlighted that “continuous and seamless pathways of learning” have been emphasised to enable progression from schooling into employment (South Africa. DHET, 2010c, p. 1). This policy position was further stressed at the launch of the Qualifications Council for Trade and Occupations in February 2010, where the Minister of Higher Education and Training committed his department to “improve entry points into and pathways through the learning system”. He further emphasised that “learners from Higher Education and Further Education institutions need to proceed to the skills development

³ The Freedom Charter is the foundation to South Africa’s Constitution. It is a statement of core principles designed by the people outlining their vision for democratic society.

system and the workplace seamlessly, with easy pathways across the different learning sites". The Department of Higher Education and Training (DHET) in its Strategic Plan 2010-2015 also stressed the commitment to "meaningful learning pathways ... across institutional and workplace education and training" (South Africa. DHET 2010a, p. 19) and committed the DHET to create pathways for moving 'up and down' (e.g. between universities and colleges) in order to find meaningful progressive pathways, as well as pathways to transfer between institutions at similar levels, and also 'sideways' between SETAs (occupational training) and learning institutions (South Africa. DHET, 2010a, p. 46).

In 1998 government legislated a skills development system for South Africa which was overseen by the Department of Labour. This created the way for the establishment of the National Skills Fund and the Sector Education and Training Authorities (SETAs). The SETAs were mandated to be the custodians of education and training for their appointed economic sectors. There were originally twenty-three SETAs in each of the country's key economic or social sectors. Buchler (2012) explained that "the process [where skills authorities monitor and support education and training within their economic sector] is one where SETA implementation of its sector skills plan and contribution to broader sector development is funded through the provision of learning and skills development programmes (both qualifications and unit standards) which is monitored and quality assured by SETAs" (p3). This system has faced numerous challenges and the key limitations related to green skill planning are analysed and explained in greater detail below and in Chapter 5. In short, however the SETA structure has widely been regarded as the weakest part of the system as discussed below.

The vision was ambitious, the intent solid, the optimism legendary, but things did not go according to plan, and in 2000 the Department of Education and Department of Labour called for a review of the NQF. The study team appointed to review the NQF found general dissatisfaction with the pace of implementation especially in respect to access, progression and redress. Furthermore, the architecture of the NQF, the embracing of policies, regulations, procedures, structures, and language, was experienced as unduly complex, confusing, time consuming and unsustainable (Skills Development Handbook, 2010).

In 2008, in response to these issues, the South African NQF Act 67 of 2008 was promulgated; this Act saw the following changes to the NQF, and several key structural amendments:

- The NQF levels changed from eight to ten;

- The NQF comprised a single integrated system with three relatively autonomous sub-frameworks (see Figure 3.8. below);
- Each sub-framework is governed by a quality council (as illustrated in the figure below): the Higher Education Qualifications sub-framework – Council for Higher Education (CHE); General and Further Education and Training sub-framework – Umalusi; and the newly formed Occupational Qualifications sub-framework – Quality Council for Trades and Occupations (QCTO) (see Figure 3.8);
- The three quality councils now assume the responsibility to generate and register qualifications.

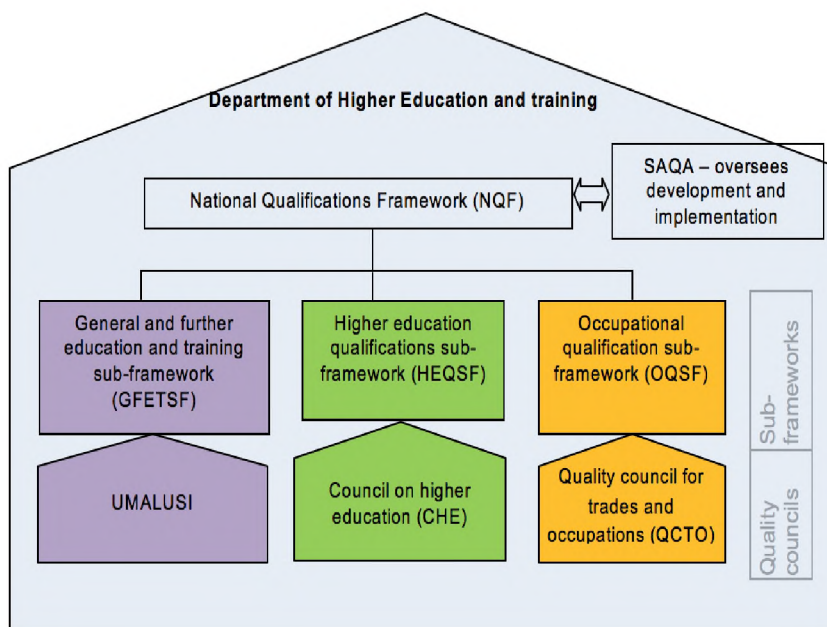


Figure 3.8: South African NQF and sub-frameworks

Figure 3.9. that follows provides an overview of South Africa's National Qualifications Framework (NQF) – it reflects the pre-2008 NQF and the current NQF comprised of three integrated sub-frameworks. The diagram also reflects the main types of qualifications that are found in the various bands at the different NQF levels.

Prior to 2008		
NQF	Qualification Type	Education Band
8	• Doctorates and post doctorates	Higher Education Band
7	• Higher degrees; professional qualifications	
6	• Degrees; higher diplomas	
5	• Diplomas; occupational certificates	
4	• School/College/Trade Certificates	Further Education Band
3		
2		
1	• Up to Grade 9 ABET level 4	General Education Band

Figure 3.9: The changing South African Qualifications Framework –

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

showing pre-2008 and current NQF

Although there are some remaining challenges (e.g. the battle for level 5 qualifications on the NQF, and who controls it with all three councils potentially having an interest to design qualifications for this level), the general changes have been positively received. The NQF shift reflected in Table 3.4. illustrates a move away from top-down to a more differentiated, bottom-up framework with greater input from educational institutions in the design of qualifications (Raffe, 2009; Allais, 2010). This illustrates a firm move away from outcomes based qualifications, where qualifications were defined and determined outside of educational institutions (Allais, 2010). Parker and Walters (2008) further commented that this represents a move away from trying to prescribe a 'common ground' applicable to all education and training to rather seeing the NQF as a 'common ground' that will be constructed slowly and incrementally.

To ensure coherence between the newly defined three sub-frameworks, level descriptors have been defined, which the South African Qualifications Authority oversees. As a participant in meetings where these were discussed, I can describe the reception to them as lukewarm at best. There was vociferous debate on their practicality and the limitations of any structure attempting to define sufficiently the "essence of different levels in different knowledge areas" (Allais, 2010, p.24). Allais, reflecting on her work experience within a quality council (Umalusi), argued that standards and levels are defined in curricula and assessment and she supported the notion that they will not be actively used by institutions or standard setting structures.

Reflecting on the changing NQF, Allais, Raffe and Young (2009) described the shift as a change from a transformational framework to one that resembles a more reforming framework. They likened South Africa's original NQF to a transformational framework, which uses a proposed future system as a starting point and then defines qualifications it would like to see in a transformed system. A reforming framework they further contend is "one that takes the existing system as its starting point but aims to improve it in specific ways, for example by enhancing quality, increasing consistency, filling gaps in provision or increasing accountability. It typically has a statutory of regulatory role" (p. 25).

From this, it is evident that early ambitious dreams have been moderated and more modest views are emerging in South Africa around the role of NQFs. Reflecting on the (r)evolving conceptions of the NQF (see Figure 2.9. below), it can be seen that early conceptualising of the NQF reduced it to a register of qualifications that has been critiqued for being too narrow and technicist (Bolton & Keevy, 2012), while seeing the NQF as a comprehensive system implies that it encompasses the whole system for education and training. The NQF as a social construct (Walters & Isaacs, 2012)

implies that “we as social actors in society not only theorise about, construct and implement it [an NQF], but we also enable, actively change or work against it” (Isaacs, 2001, as cited by Bolton & Keevy, 2012, p. 279). Bolton and Keevy (2012) noted that seeing the NQF as a mechanism to facilitate communication deepens understanding of the NQF as a ‘relay’, both as message (what is relayed) and communications-relaying device (mechanism for relaying information). Bolton and Keevy (2012, p. 273) proposed a fifth conceptualisation: understanding the NQF as a ‘relational principle’ – “an organisational principle facilitating relational thinking about the education and training system as a whole and how its constituent parts relate to each other, to development and to the world of work”. They argued that this would connect and link the four discussed conceptualisations (see Figure 2.9. below) and enable better articulation of the complexity of the NQF (Bolton & Keevy, 2012).

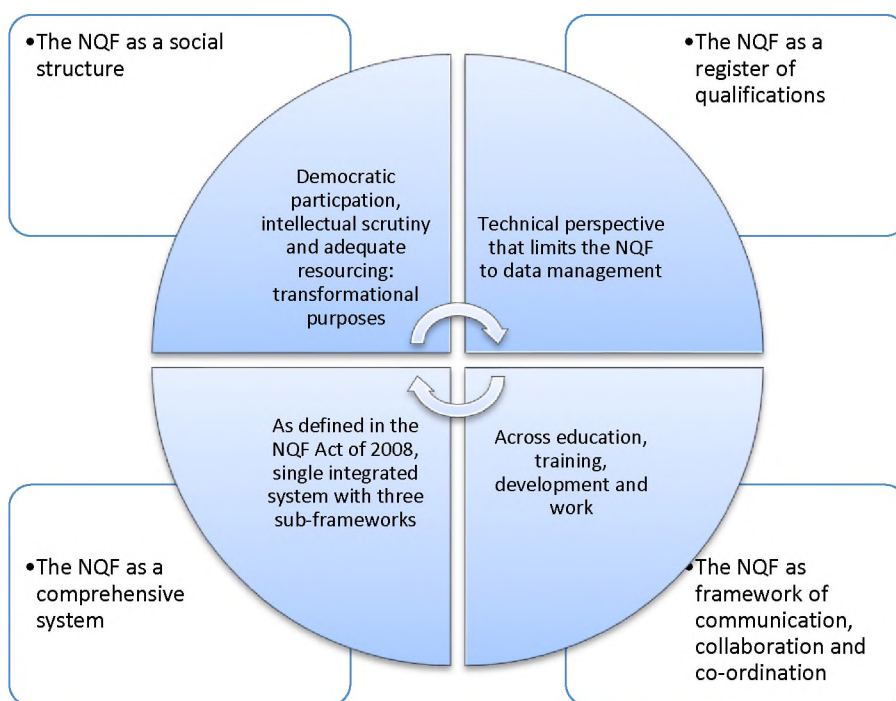


Figure 3.10: Conceptualisations of NQF (as cited in SAQA Bulletin, February 2012)

The conceptualisation of the NQF as a relational principle (Bolton & Keevy, 2012) has greater significance when one explores it against the revised systems of post-school education and training, whose architecture presents a complex network of education and training systems and structures. How the objectives of integration, access, articulation, and progression can be

achieved across and between the three sub-frameworks of the NQF becomes a key implementation question and is hence central to a study on learning pathways and what enables and constrains learning pathways.

In concluding my discussion on the NQF, I reflect on Isaacs (2012) statement that the NQF acronym stands for 'No Quick Fixes' and as such it is not a "blueprint to be followed slavishly" but rather a "dynamic social construct that is and can be shaped through democratic participation and intellectual scrutiny" (p. 76).

The vision for a single integrated, post-school system remains elusive because although the structural and institutional structures undergo change, the transition of the broader educational project (social equity, access educational, redress) remains a challenge. This raises further constraints on a new emerging sector and how it is appropriated within and provisioned for within the prevailing education and training system.

3.2.2.2 The transitioning skills development system

This section is focused on the post-school sector and how education and training within the post-school sector is conceptualised and provided. This discussion will form the foundation of the discussion in Chapter 6.

The post-school sector in South Africa is comprised of the following institutions which provide formal education and training:

- Public universities, national institutes of higher education and other (private) higher education institutions;
- Public FET colleges and private FET institutions;
- Adult education centres and all other adult education
- Levy-grant institutions: the Sector Education and Training Authorities (SETAs) and the National Skills Fund (NSF);
- Regulatory and other institutions: a range of regulatory institutions and other organisations, systems and frameworks: the National Qualifications Framework, the South African Qualifications Authority (SAQA), the three Quality Councils and the National Skills Authority (NSA), and the National Student Financial Aid Scheme (NSFAS). (South Africa. DHET, 2013a, p.xi)

As discussed above, issues of access are important in South Africa given its history outlined in Chapter 1. In the discussion thus far, I have explored the South African NQF and its commitment to changing the lives of young South Africans as captured in its objectives and framing. But the challenge is far from over. The only way out of the poverty trap for many is better educational

opportunities. Hence post-school opportunities remain critical to educational transformation. Of the 10.4 million youth between the age of 15 and 24 years, 3.5 million are not in employment, education or training. Weak levels of quality of education amongst this youthful cohort additionally blocks access for them to compete in the job market, and worsens the crisis of the burgeoning cohort of out of employment youth (Lotz-Sisitka et al., 2013). Hence the need for a proactive and well-functioning skills development system.

2009 saw a drastic change to the educational landscape with the splitting of the Department of Education into two departments: a Department of Basic Education (DBE) and a Department of Higher Education (DHET). Skills development, which was previously controlled by the Department of Labour, was now moved to DHET. This move has been positively received as occupational skills development needed to be an independent statutory body, which would give it more legislative clout (Allais, 2010). The discussion below elaborates the broader transitioning skills development context. Figure 3.11 below illustrates the chronological overview of the transitioning skills development system.

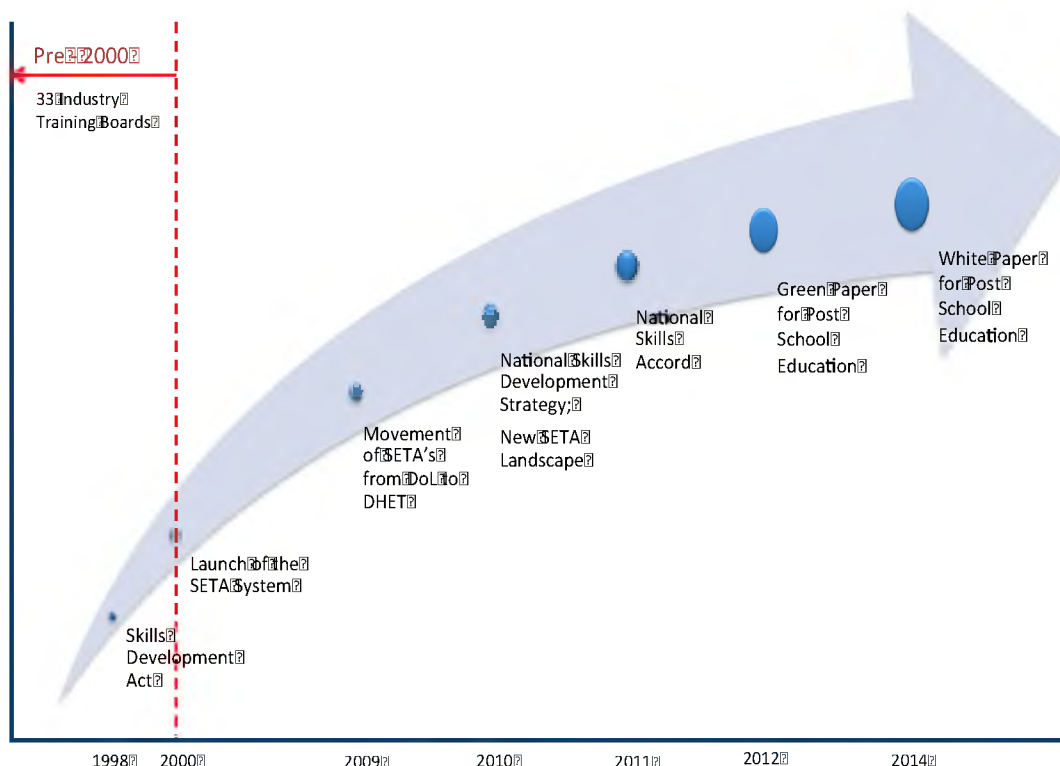


Figure 3.11: A transitioning skills development system

The Skills Development Act (South Africa, 1998) explains that skills development is intended to redress the inequalities in skills development for adults in order for them to access employment

and income opportunities. The intention to utilise skills development as a vehicle to address “structural problems of the labour market” is consistently carried through in all skills development legislation as illustrated in the following extract from the skills development implementation report: “transformation remains at the forefront of all skills development activities so as to create employment opportunities for the previously disadvantaged communities in our country” (South Africa. Department of Labour [DoL], 2006, p. 32).

The release of the prevailing National Skills Development Strategy III (NSDS III) (South Africa. DHET, 2011c) strategy which is the “overarching strategic guide for skills development and provides direction to sector skills planning and implementation in SETAs” (NSDS III, p. 9) signalled that despite the inroads made by NSDS I and NSDS II, the country continues to be constrained by a lack of skills emanating from skills shortages and skills mismatch. I have outlined the two structural features of NSDS III in Table 3.4 in order to highlight its orientation, intentions, and scope, which will be referred to in Chapter 6, when reflecting on green skills development in South Africa.

Table 3.4: Overview of NSDS III

Seven pillars	Eight goals
Sector strategies	Establishing a credible institutional mechanism for skills planning
Relevant sector based programmes	Increasing access to occupationally directed programmes, both intermediate level as well as higher level professional qualifications
Professional, vocational, technical and academic programmes	Promoting the growth of public FET college system that is responsive to sector, local, regional and national skills needs and priorities
Incentives for training and skills development capacity in the cooperative NGO and trade union sectors	Addressing the low-level of youth and adult language and numeracy skills to enable additional training
Partnerships between public and private training providers between SETAs addressing cross-sectoral and inter-sectoral needs	Encouraging better use of workplace based skills development
Programmes that contribute towards the re-vitalisation of vocational education and training	Building career and vocational guidance
An increased focus on skills for rural development to support government’s prioritisation of rural development	Encouraging and supporting co-operatives, small enterprises, worker initiated, NGO and community training initiatives
	Increasing public sector capacity for improved service delivery and supporting the building of the developmental state

The multifaceted nature of skills development and the complex interactions between key structures and stakeholders are illustrated in Figure 2.13 below. Financing of the skills system is through a skills levy system, which is regulated by the Skills Development Levies Act (South Africa, 1999b). Employers pay a levy to the South African Revenue Service (SARS), which is 1% of their employee payroll. Mummmenthey (2010) reflected that this is low as international investment in training is usually between 4 and 7%. Twenty percent of the levy goes to the National Skills Fund (NSF) and the other 80% goes to the relevant SETAs (e.g. a conservation company's levies would go to the skills authority that houses a conservation chamber). Employers then submit workplace skills plans and Annual Training Reports to their SETA which detail the skills needs of their organisation. They can then claim back 50% of their training spending. This is essentially how the skills system is funded in South Africa. This also illustrates the central role of SETAs, who are responsible for analysing the collected workplace skills plans and annual training reports and who compile sector skills plans which enable them to identify scarce and critical skills and outline sector training priorities.

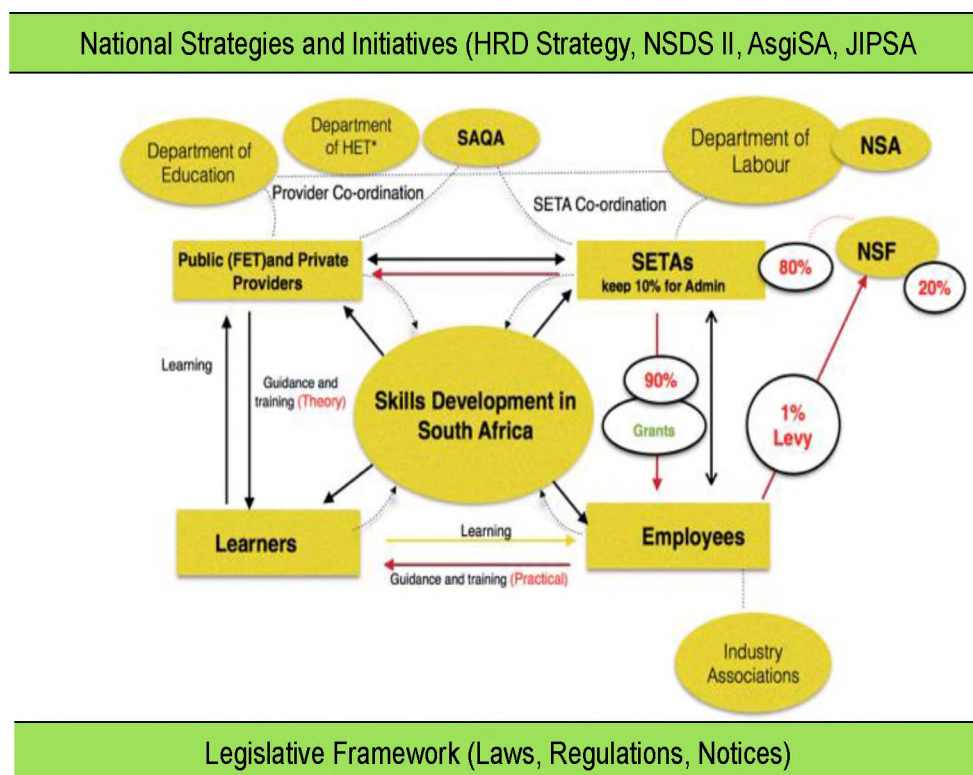


Figure 3.12: The skills system (Adapted from Mummmenthey, 2010)

James (2009), drawing on the work of Mayer and Altman (2005), highlighted some of the key problems with the SETA system:

Many employers disregard the new levy-grant system or view it as little more than an additional tax burden impacting negatively on cost structure and profit margins. Government has reacted angrily to such arguments, blaming the companies for not taking seriously the skills development of their staff. Training authorities and employers, in sharp contrast, are critical of an over-bureaucratized system. (James, 2009, p.2)

James further argued that it is the bigger companies and their employees who benefit from the Skills Training Levy System as smaller companies “struggle to complete the necessary paperwork”. This is supported by the SETA Review conducted by the Human Resources Development Council (Kraak, 2013), which stated that the SETAs have had little impact on the informal sector or on the employability of unemployed people. Both these arguments illustrate that the skills system is not making the envisaged contribution to equity and social justice.

In Chapter 1, I outlined the need for a differentiated skills system in South Africa. During apartheid the apprenticeship system was a powerful institution that trained large numbers of intermediate skilled white artisans. Kraak & Press (2008) has linked the issues with current intermediate skilling to the demise of the apprenticeship system. However, Wedekind (2013) argued that

Apprenticeship has a very specific history linked to slavery, indenturing, protection of white labour and, more recently, the role of state enterprises in dealing with unemployment ... apprenticeship has on numerous levels been exploitative and a form of modern slavery; apprenticeship has been used as a vehicle for social engineering; apprenticeships have been associated with a limited set of (primarily technical) trades and occupations; and technical occupations have tended to be viewed as being on lower levels of the status ladder in comparison with white collar work. These understandings and experiences run deep in individual and community understandings of the concept and shape their reactions to change. (p. 4)

Currently the three primary pathways for intermediate skilling are the apprenticeship route; the technical college route and the learnership route. Kraak & Press (2008) argued that this is the inherent problem with the labour market for intermediate skilling: although learners may choose one of these pathways they are weakly linked to each other and to employment. Poor articulation characterises the relationship between employers, SETAs and colleges that further complicates the problems of learners that seek work after accessing a programme.

Further problems within the skills development system are the systems and processes of the heavily bureaucratized quality assurance systems of SETAs, which in reality stifle innovation by providers, especially those working with entry-level learners. The system has been critiqued for being provider-driven with providers receiving funds for training of learners that have no real

pathways. The focus on qualifications appears to have been excessive: in some sectors there has been no uptake of about 75% of SETA qualifications developed at great cost.

Finally, in closing the discussion of the skills development system, I draw on an extract from the HRDCSA SETA review, which states:

There is a concern in South Africa about the economy and its ability to achieve the inclusive growth that will enable serious reductions in unemployment and poverty. Education and skills levels are a key enabler of economic growth. Highly skilled people create jobs and suitably skilled people can be absorbed into employment when jobs are created. Entrepreneurs also create jobs, particularly when the entrepreneurs are themselves skilled... currently the South African labour market is characterised by low levels of education and skills ... those entering the labour market with acceptable levels of education (Matric or a Bachelors degree for example but also occupational qualifications at various NQF levels) are viewed by employers as not being adequately prepared for the world of work. (Kraak (2013), p. 4)

The extract highlights some key pointers on how the relationship between education and the economy is viewed. Although there is an obvious relationship between education, training and the economy, they are equally related to social aspects trade and political policies and practices, thus it must also be acknowledged that the relationship is a complex one (Powell & Lolwana, 2012). Allais (2014) critiqued the idea that the economy is seen as a model for education and as the solution to economic problems; this, she argued, represents a “lack of willingness to tackle structural economic and political problems” (p. xxi). Wedekind (2013) and Allais (2014) both argued that there is an emphasis on the design of the system and institutions’ size and shape but insufficient attention is given to the delivery of education, curriculum and knowledge; herein, they would argue, lies the real issue with the skills development system in South Africa.

In Chapter 6, I will explore in greater detail the post-school system and how the skills development system is working or not for green skills in South Africa.

3.3 Conclusion

In this chapter I have started to unfold the tale of two transitions. As the story unfolded, the multiple, complex transitions of these two systems attempting to deal with catastrophic landscape pressures, became clearer. The tale of transition to a more sustainable society thus remains a complicated one. Both these systems remain critical to the transition to a green economy and they both set the foundation for the rest of this thesis, which will explore the enabling of learning pathways for green skills.

CHAPTER 4: DEVELOPING A CONCEPTUAL UNDERSTANDING OF ENVIRONMENTAL LEARNING PATHWAYS

*Mandela taught us the power of action, but also ideas;
the **importance of reason and arguments**;
the need to study not only those you agree with,
but those who you don't ...*

Barack Obama, 10 December 2013 speech at Nelson Mandela Memorial

4.1 Introduction

This chapter builds on and extends the theoretical work introduced in Chapter 2. In this chapter I aim to frame the underpinning theoretical influences that have shaped the design and methodology of this study and provided the theoretical basis for making sense of environmental learning pathways. The study's focus on education to work transitions that moved beyond early entry into the labour market necessitated the knitting together of theoretical ideas from three related complementary theoretical fields: learning pathways literature, learning and work transitioning literature as well as relevant career literature. The broad learning to work transitioning literature was scoped to complement the learning pathway reading as this body of work enabled me to understand the mechanisms and processes inherent in pathway construction. Finally, career passage ideas strengthened the theoretical tools that shaped the study. These theoretical areas work together in this study to enable me to build an understanding of environmental learning pathways within a transitioning education system. The critical realist framework in this study plays both an underlabouring and a critical analytical role and assists to deal with the multi-mechanisms that are always at play within open social systems.

4.2 Connecting to the theoretical orientation introduced in Chapter 2

In Chapter 2, I provided an orientation to two frameworks (multi-level perspective and the critical realist laminated systems), which frame the study and provide the tools to conceptualise the shift to a more sustainable society. These frameworks helped me to examine transitioning systems in this study (education and environment) as complex, multi-sectoral and co-evolutionary, comprising landscapes, regimes and niches. It helps us to understand how existing regimes which operate at the meso-level and provide the stable configuration of how institutions and policies,

operate as 'normal'. The niches provide the innovation spaces (see Chapter 6) that initiate change and threaten the status quo.

This chapter situates the discussion within the South African policy discourse of meaningful learning pathways (South Africa. DHET, 2010a). The notion of seamless learning pathways has been integral to the emergence of the South African National Qualifications Framework (NQF), with its foundational commitment to objectives of facilitating access, mobility and progression within education, training and career path development, as reflected in the NQF Act No. 67 of 2008 (South Africa, 2008a) and the underpinning NQF objectives (Allais, 2010; South Africa, 2008a) discussed in Chapter 3. This chapter thus outlines the theoretical tools that enabled me to examine how environmental learning pathways in and for sustainable development emerge.

Figure 4.1 below provides an orientation to guide the reader through the unfolding logic of this chapter. I explore the international literature around learning pathways and highlight some of the main orientating constructs. I then explore how to make meaning of learning pathways in a sector involving extensive boundary crossing and navigating educational and work systems to craft specialist pathways. This necessitated an examination of life course, learning and work transitioning and the job mobility patterns that characterise these learning pathways. These middle range theories provided the study with descriptive tools to make meaning of the emerging learning pathway insights.

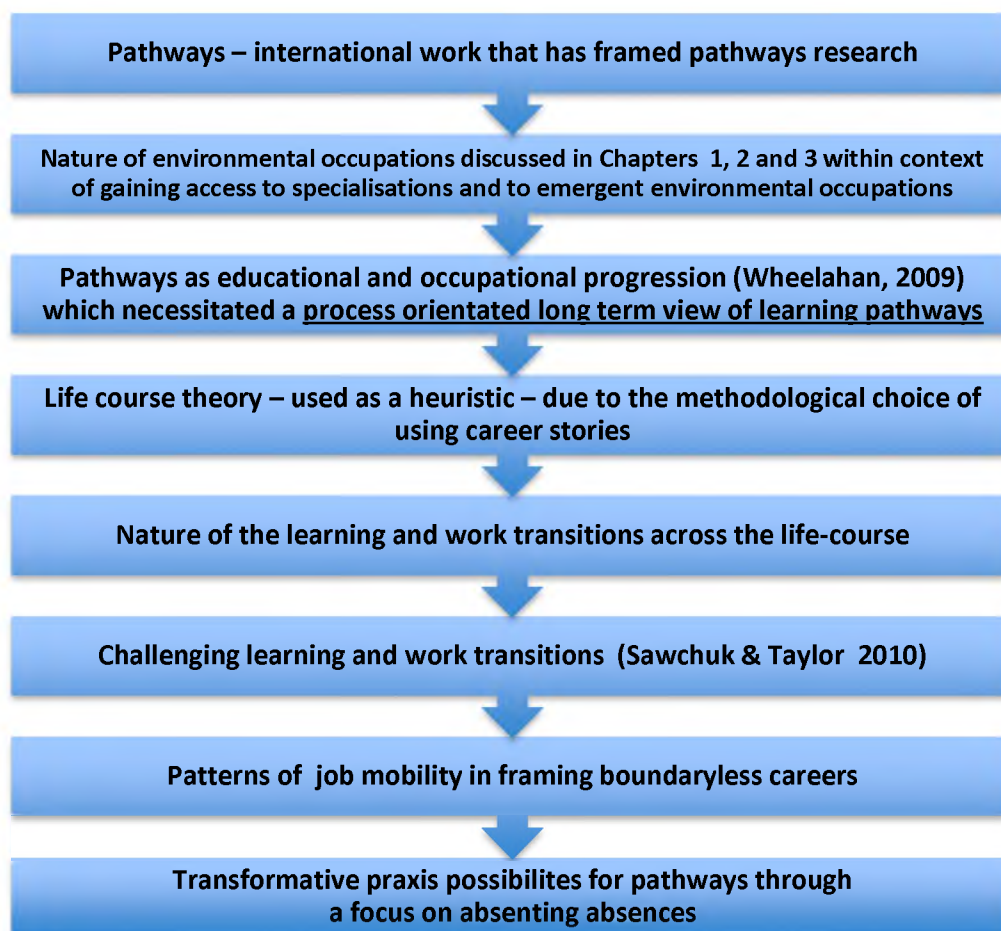


Figure 4.1: Framework of scope of literature discussed in chapter

The discussion below presents an introduction to learning pathway literature.

4.3 Developing a conceptual understanding of learning pathways

Evans and Furlong (1997) highlighted that over time international research has utilised four metaphors to define the phases through which research and policy have explored youth transitions: 1) niches, 2) pathways, 3) trajectory, and finally, 4) navigation. Early conceptualising used an analogy of ‘filling society’s *niches*, where the emphasis was on fulfilling ‘growth tasks’ to ensure successful integration into adult roles. The concept was expanded to the idea of *pathways* to describe the longer and more complex transition process. The emergence of *trajectory* as a viable metaphor attempted to expand the notion beyond government-designed pathways to include social forces that shape youth transitions. More recent attempts have aimed to express the individuals’ roles in ‘shaping their lives within the opportunities and constraints that faced them; these have utilised the metaphor of *navigation* (Raffe, 2003; Furlong, 2009). Raffe (2003) cautioned though that these metaphors should not be viewed as distinct periods and that pathways must rather be designed to meet the needs of the people who use them. The concept of

‘pathways’ has been the most widely utilised both in policy and research and the most extensively used in South Africa. In the discussion below I illustrate some of the work and deliberation around the pathways concept in order to develop a broader conceptual understanding of pathways as an empirical phenomenon.

Despite extensive use of the learning pathways concept in policy, both locally and internationally, in countries such as the Netherlands, Norway, Germany, Australia, New Zealand, Scotland and Denmark (Vaughan, 2003; Raffe, 2003; McKenzie, 2000b; OECD, 1999), it remains a metaphor that is imprecise. It is used in a variety of ways to express different meanings (Raffe, 2003). Raffe (2003) acknowledged that the concept is a very useful bridge between policy and research, despite the fact that learning pathways alone are not a recognised theory or a rigorous theoretical tool.

Pathways have served as an influential organising construct and the imagery of the pathway, with its sense of order and structure, and linked education and training experiences that lead to employment, has had a significant impact on educational policy (McKenzie, 2000a; McKenzie & Hillman, 2001). In a study by Harris, Rainey and Sumner (2006), ‘learning pathway’ was interpreted as a ‘journey of learning’. Their research expanded notions of pathways and challenged the idea that the pathway analogy is a ‘*deterministic* notion’ with a set trajectory. Rather, the study highlighted that pathways are ‘continuous’ and should be seen as a series of stepping stones, making the trajectory ‘fragmented and discontinuous’. Another highlighted feature of pathways was *direction* – pathways lead somewhere, although where is often not known or understood, and sometimes they change direction. In reflecting on the complex patterns of movement, the Harris et al. study (2006) concluded that pathways are not linear and seamless, but rather “stepping stones, zig-zags or lurches” (p. 3). The term ‘crazy paving’ was used to describe a range of pathways from ‘erratic’ to ‘merging’, ‘tangential’, ‘parallel’ and ‘swirling’ (Harris et al., 2006, p. 3). Raffe (2003) outlined how the term ‘pathways’ helped to express length, and complexity and illustrates something longer than a step. In addition, pathways can interconnect. Travellers can choose between pathways, change direction or they may “set off with no clear destination in mind” (ibid., p4).

The Australian Finn report (1991) as reported by McKenzie (2000a) outlined five main elements of pathways, which have had a very significant influence on conceptualising research on pathways and which continue to represent some of the core foundational ideas shaping work around pathways. McKenzie (2000a) reflected that each of these elements (which together provide a

coherent structure of pathways through education and training and into work) has contributed in various ways to policy reforms:

- A set of *interrelated* experiences providing for *progression*;
- Education and training should have a *sense of continuity* even when individuals cross institutional and sectoral boundaries;
- Young people should have access to a *range of different pathways* and should be able to move from one to another *without losing ground*;
- There is a need for effective credit transfer and articulation arrangements to provide *smooth bridges* between pathways; and
- *Signposts* (information and career advice) are needed at the start of each pathway and at each junction between pathways.

(McKenzie, 2000a; McKenzie & Hillman, 2001)

The pathways concept has proven difficult to apply and identify empirically (McKenzie, 2000a, 2000b). Transition data has always presented challenges as it has been limited in its ability to measure social change and in its longitudinal range (Vaughan, 2003; Raffe, 2003). McKenzie (2000a) noted that most empirical work linked to pathways research is focused on either 1) policy reviews linked to institutional and formal opportunities in different educational sectors attempting to distinguish main types of pathways (Raffe, 2003); or 2) interconnections between pathways and what young people do (i.e. the *collective* gap and learning pathway); or 3) the career journeys people take which may not coincide with formal structures (the individual gap and/or story) (Raffe, 2003; Harris et al., 2006; McKenzie, 2000a; McKenzie & Hillman, 2001).

Current empirical work across the three areas discussed above, reflects that although one-way models of student movement leading to university are well documented (Walther, du Bois-Reymond, & Biggart, 2006), “relatively little is known about the educational and employment pathways of students moving between the sectors” (Harris et al., 2006, p. 11) which is significant to this study as indicated by Environmental Sector Skills Plan (South Africa. DEA, 2010a) which showed that work in the environmental sector is characterised by boundary crossing. Pathways research to date has focused largely on youth studies (Raffe, 2003; Vaughan, 2003; McKenzie, 2000b; Harris et al., 2006; Walther et al., 2006), concentrating mainly on school to work transitions. There is also relatively little research on those who don’t reach university, or those whose learning pathways hardly exist, or are virtually absent, an issue which is of interest in the South African social context as illustrated in Chapters 1 and 3. An area not expressly addressed in

previous research, which is of interest to the environmental sector in South Africa and the envisaged transition to a green economy, is how people create pathways into specialised jobs; this is explored in this thesis in Chapters 7 and 8.

‘Pathways engineering’ emerged in the 1990s as a very significant component of education review in many countries like the Netherlands, Norway, Germany, Australia and Denmark (Raffe, 2003; McKenzie, 2000a). In 1999, the OECD comparative review of education-to-work transitions in 14 countries reported that most reviewed countries had attempted to make the pathways by which people move from school to work more **attractive, open and flexible**, and had attempted to provide more opportunities to combine vocational learning with general education (OECD, 1999; McKenzie, 2000a). These policy ideals resonate with South African policy contexts and are explicitly outlined in the NQF objectives and NQF Act described in Chapter 1. The focus on main types of pathways helps to raise concerns on ‘academic drift’ – the favouring of the general pathway as opposed to the vocational. Raffe (2003) warned that this is often hidden by the way tracks are classified and interpreted and used. Raffe (2003) explained that pathways discourse is very popular with policy makers as pathways can be constructed to lead to particular destinations and they can make some destinations easier to reach than others.

In expanding these ideas, Wheelahan (2009) outlined two important purposes of pathways, both of which are relevant to this study: firstly, pathways increase the effectiveness and efficiency of education systems – this, she argued, means that individuals need to be able to move between “different types of qualifications and different occupational sectors with ease” (p. 6) to reduce time and costs to individuals and governments. The second purpose is linked to equity and social inclusion: pathways aim to give access and opportunity to disadvantaged individuals (Wheelahan, 2009). Pathways are thus an important mechanism to redress issues related to widening participation in education by students from disadvantaged backgrounds, which is relevant to South Africa’s transition to a more just and sustainable society. Wheelahan explained further,

Pathways must support educational and occupational progression if they are to contribute (to) the first criterion, and they must provide social and educational opportunities for students from disadvantaged backgrounds if they are to contribute (to) the second. (2009, p. 7)

Understanding pathways with a frame of educational and occupational progression is a useful idea in this study as it allows me to examine the development of the person across the life course

within the context of an occupation (Wheelahan, 2009, p. 38). This is explored in Chapters 7 and 8 in this study.

Thus it can be argued that integral within a well-articulated and integrated system is the emergence of parallel and second-chance pathways, which learners can use to move through quality education provisions from basic education through upper secondary education into higher education. Hoppers (2009) argued that they should be able to do this how, when and where they want to, in order to realise their chosen pathways. The emergence of parallel and second chance pathways are critical for enabling access for disadvantaged and marginalised learners, and the Association for the Development of Education in Africa conference in 2008 raised the importance of this within African contexts (Hoppers, 2009).

A particular characteristic of the focus on educational transition in South Africa is the conceptualisation of transitions through a metaphor of pathways. The notion of pathways has been integral to the South African educational context and is fundamentally linked to principles of mobility and progression. Discussed against the socio-political intentions of education in South Africa (see Chapters 1 and 3), the South African intent behind this conceptualising resonates with Vaughan (2005) who highlighted that a “pathways framework on transition says to young people: no matter what your background and how successful or unsuccessful you were at school, there are options for you; there are pathways to a good career and future” (p. 174).

Bauman (2001) and Giddens (2006) have both commented on the conditions of late modernity and the need for ongoing reflexivity, and both noted that lifelong learning (and the flexible learning pathways) has become the main educational consequence of such conditions (Lotz-Sisitka & Ramsarup, 2012b). Field et al. (2009) noted that transitions research in the context of youth transitions to university is comparatively mature and is increasingly giving attention to the relationship that exists between youth agency within a recognition of structures and constraints and is “informed by theoretical understandings of learning lives in late modernity, sometimes conceptualised, following Ulrich Beck, as ‘risk society’” e.g. Walther et al. (2006) as cited in Field et al. (2009).

However, the concept of ‘learning pathways’, despite its potential as a useful organising concept, has been criticised for:

- 1) linearity and determinism highlighting that learning pathways traditionally tend to ignore complexity, most often implying transitions are uni-directional and emphasising a

distinction between educational pathways and labour market destinations and ignoring the overlap of study and work;

- 2) economism – this critique centres on an over-emphasis on transitions through education into the labour market and ignores other transitions such as family, household or lifestyle transitions; and
- 3) individualism – “[learning pathways discourse tends to] ... ignore social structure and inequality; it implies that pathways are equally accessible to everyone and that if people differ systematically in the way that they use them, this is merely because they want to go to different places”. (Raffe, 2003, p. 4)

These perspectives and critiques on learning pathways discourse are helpful for developing a fuller understanding of the meaning of learning pathways discourse in a South African context, particularly in the light of the stated commitment of the NQF to address transformation issues and its struggles to achieve this (as discussed in Chapter 3). Thus, a concept of learning pathways in South Africa ought not to ignore issues of social structure and inequality, nor ignore complexity; and while important, the learning into work relation is not fully adequate for understanding learning pathways in South Africa, as other learning relations also emerge as being significant, for example, the learning – public good and learning – democracy learning relations (Lotz-Sisitka & Ramsarup, 2012b).

Notions of systemic/institutional pathways and individual pathways have emerged across the literature as indicated in the discussion above. This apparent dualism presents a challenge to pathway work. In this study, the critical realist lens enabled me to transcend the dualism between the systemic pathway and individual pathway through its emergent properties in open systems ontology (Sayer, 2000). The stratified ontology (Sayer, 2000) of critical realism enabled me to work with pathways as a laminated totality (Bhaskar, 1993). This allows one to work with social phenomena like learning pathways by explaining them at different levels or scales and acknowledging that in “open systems a multiplicity of mechanisms (conditions, agencies), emergent at different levels of reality, is always involved” (Price, 2012a).

To develop an understanding of the nature of environmental learning pathways, it is necessary to reflect on people’s educational and occupational progression and it requires a careful examination of their transitions. The section below explores this by providing a critical understanding of learning and work transitioning.

4.4 The nature of learning and work transitions ... within transitioning systems

4.4.1 Conceptual understanding of learning and work transitions

This study has the intention to understand the real pathways followed by key environmental workers in contexts of great change. In this context, the nature of the actual institutionalised and non-institutionalised learning and work transitions become a very useful lens for understanding pathways formation. In this section, I discuss learning to work transitions and how they facilitate understandings of key issues underpinning pathway construction.

Raffe (2008) highlighted that transition system research often appears theoretically eclectic and fragmented so researchers tend to borrow from other theoretical domains. George (1993), writing from sociological perspectives on life transitions, emphasised that transitions are too heterogeneous and too dependent on social context to be captured by a single generic model. Transitioning questions paint a broad canvas of research stories that span different fields, so economists, labour market analysts, human capital development analysts, sociologists, educationists as well as policy makers, have an interest in transition research, each with different foci.

Field (2012) reflected that the “boundaries and expectations of transitions though the life course are changing, at the level of the individual and at the level of the wider society” (p. 1). These positions raise important questions about how transitions are changing, how they can be more effectively managed, and how we need to pay more attention to how we conceptualise learning and work transitions within changing societies and changing occupations.

In this first section, to help me develop a perspective and a framework for creating meaning of this concept of transition, I step back initially to provide a brief overview of the general meanings of transitions, how they are viewed in the literature and then I highlight components that I need to consider.

Fenwick (2013) broke down the word ‘transition’ as follows: “the Latin *transitus* (passage; crossing); the Late Latin *transire* (go over, cross); the Latin *trans* (beyond, across)” (p. 1). This deconstruction supports the idea that inherently transitions involve movement from one point to another.

Kralik, Visentin and Van Loon (2006) cautioned that it is important that we do not conflate ‘transition’ as simply another word for ‘change’ and in our work understand that it is the “process involved in adapting to the change event or disruption” (p. 322). Supporting the idea that transition involves a passage of change, Chick and Meleis (1986) explained,

Transition, as passage from one life phase, condition, or status to another, is a multiple concept embracing the elements of process, time span, and perception. Process suggests phases and sequence; time span indicates an ongoing but bounded phenomenon; and perception has to do with the meaning of the transition to the person experiencing it. (p. 239)

Burns (2010) noted that much social analysis records transitioning processes from one period to another (modern to late modern), one state to another (feminising a profession), or the importance of one variable to another (labour force data, levels of education, retraining).

Wheelahan et al. (2012), writing from an education to work perspective, also highlighted that transition refers to “movement from one state to another, such as from education to work, or work to unemployment or work to retirement” (p. 4). Drawing on the ideas of Fenwick (2013), Chick and Meleis (1986), Kralik et al. (2005), Brzinsky-Fay (2011) and Burns (2010), transition involves a process, and an outcome, one or more individuals (as it can be individual or collective) and a context/s. Within research, it can allow us a vantage point into these aspects, from both a macro (structural and institutional) level as well as a micro (individual) level. Both these aspects are investigated within this study (see Chapters 5, 6 and 7) and reflected on in Chapter 8.

‘Transitions’ and ‘trajectories’ are two terms that pervade this literature; they are interrelated but analytically separate (George, 1993; Pallas, 2003). The discussion above has illustrated that transitions are changes in status, discrete and bounded in duration (first job; transition into school) although the consequences could be long term (George, 1993). Trajectories, on the other hand, are “long term patterns of stability and change which often include multiple transitions” (George, 1993, p. 358). Pallas (2003) explained further that trajectories are sequences of transitions but also emphasised that trajectories involve the attributes of an individual. He further drew links between trajectories and educational pathways as discussed in Chapters 7 and 8.

Wheelahan et al. (2012) concurred that trajectories refer to the “general direction in which individuals’ multiple transitions take them” (p. 4). Sampson and Laub (1990) also emphasised that “interlocking nature of trajectories and transitions within and across life stages ... may generate turning points or a change” (p. 610).

Eccelstone (2009), writing with a focus on individual transitions, agreed that transition could involve movement but argued that it is much more than this. She proposed that transition was a “change process but also a shift from one identity to another” (p. 125). Life course researchers, like Eccelstone, argued that effective transitions require us to understand how people progress cognitively, emotionally and socially at different stages and how they navigate the complex

demands of different contexts (p. 126). Eccelstone (2009) summarised her ideas into three key meanings of transitions: 1) navigating pathways, structures and systems, 2) becoming someone where transition is between two states of being, and 3) life as transition where the whole of life is a form of transition.

This background discussion has helped to illustrate that how we view transitions will determine how we manage them; managing transitions is a very important contemporary area of investigation (Eccelstone, 2009) in education and especially in societies like South Africa.

4.4.2 Traditions of transition research related to learning and work transitioning

Although this is an educational study, it is not only educationists that have considered the domain of transitions. In this section, I will briefly explore some of the more general scholarly approaches to transitions as they have all contributed to how understandings of transitions are shaped in modern society. Fenwick (2013), in a meta-review of transition literature related to work, outlined three traditions of research, namely developmental psychology, life course sociology, and career studies. The discussion below explores these as well as a human capital approach, which remains dominant within South African discourses.

4.4.2.1 Economic approaches: Human capital

Economists, or the ‘dismal science’ as Field (2012) called it, centre transition work mostly on understanding and matching the demand side (the labour market) with the supply side (education); analysing the labour market mechanisms that aid this relationship, and trying to explain empirically the returns on education (Brzinsky-Fay, 2011; Field, 2012). All these are framed from a position of viewing education as a means to increase the productive capacity of workers (Woodhall, 2007). Olaniyan and Okemakinde (2008) shed further light onto the mindset behind this economic framing of education and how value is placed on workers’ skills and abilities:

Education is an economic good... Economists regard education as both consumer and capital good because it offers utility to a consumer and also serves as an input into the production of other goods and services. As a capital good, education can be used to develop the human resources necessary for economic and social transformation. Focus on education as a capital good relates to the concept of human capital, which emphasizes that the development of skills is an important factor in production activities. (p. 157)

Inherently, the above views are synonymous with Woodhall (2007) who also stated that “investment in human capital produces benefits both to the individual and to the society as a whole. The individual who takes part in education or vocational training benefits by increasing his or her chances of employment and by increased lifetime earnings” (p. 219). She also highlighted

that both the costs and benefits of education also affect society as a whole since society benefits from the increased productivity of educated workers.

Field (2012) explained that economic studies on transition will measure cost of investment and cost of the returns and then compare the balance. He also highlighted that these studies are often “macro-level processes of structural transformation and institutional change” that enable economists to reflect on return of education over time. Another area of work he highlighted was the importance of preparing workers for transitions such as redundancy or unemployment. The dominance of these ideas within South African skills development discourse was highlighted in Chapter 3.

While these are helpful in developing an understanding in some respects as discussed above, they are restricted in others. If we view labour markets as mainly social institutions that exist in interrelationship with other social institutions, these approaches are unable to capture some of the institutional characteristics and complex interrelations, especially in school-to-work transitions as they extend over two social systems (education and work) (Brzinsky-Fay, 2011). As discussed in Chapter 1 (section 1.5.4), the environmental sector provides goods and services that are mostly of a public good nature. Thus, this is not a sector driven by pure economic or commercial returns on investment (HSRC, 2009). This has implications for how transition research is framed.

4.4.2.2. Developmental psychology

According to Fenwick (2013), the main interest within this tradition is to explain individuals’ responses to different types of change in their lives and in the environment. Though not central to this study’s interest, I explore the field of developmental psychology briefly below as it is widely used within this domain of research. Fenwick (2013) explained,

Work in this area focuses on the internal dynamics of transitions on life tasks; self concept ideals; coping strategies; sequence of developmental tasks which could be related to career stages. These new life tasks could pose self-concept discrepancy between actual and ideal. To manage the anxiety of these transitions – people employ cognitive and emotional coping strategies. (p. 5)

Fenwick (2013) highlighted that a challenge here is to eschew the notion of a single normative self-concept: “individuals perform and identify with diverse images of self” (p. 5). However, she elaborated that focusing on the psyche of a single individual and their experience provides a limited analysis. She also argued that when people construct their stories, individuals have to select from hundreds of memories and many learning opportunities; it can vary as to which memories are triggered in which contexts to construct a particular interpretation over time.

Developmental psychology may offer insights into the internal dynamics of transitions and to the internal world of the professional. Fenwick (2013) agreed that culture and interactions also have a role to play:

Individuals' emotional responses and notions of self within different transitions clearly are influenced by their particular cultural knowledge and cultural experiences, the mediation of their interactions by others' expectations, language and positions, the forms of activity in which they are engaged (and the tools and technology), their positionings and representations and so forth. (p. 6)

Critical realists raise a key critique of this methodological individualism, which they maintain is flawed, as structural properties and their real causal powers are marginalised and only the individual is viewed as having real existence (Sayer, 2000; Bhaskar, 1993).

Although not fully relevant to the interest in this study, work in this domain pervades organisations in terms of building self-concepts, coping strategies and building of personal brands and thus does have an influence on educational conceptions of transitions (Fenwick, 2013).

4.4.2.3. Life course

Elder, Johnson and Crosnoe (2003) regarded the life course as a 'theoretical orientation' that provides a framework for descriptive and explanatory work around social pathways, their developmental effects and their relation to personal, socio-historical conditions. It is, however, not a 'definite theory' with a "coherent system of descriptive as well as explanatory conceptions, principles, definitions, and statements which are empirically testable – i.e. no unified life course theory" (Wingens, Windzio, de Valk, & Aybek, 2011, p. 6). Kok (2007) expanded these points to explain that life course can be viewed as a heuristic device, which allows us to "conceptualise lives within the contexts of families, society and historical time" (p. 204). He defined life course as a "sequence of positions of a particular person in the course of time" (p. 204). Fenwick (2013) explained that life course studies "investigate the interactions between the economic, social, physical, behavioural, cultural, and other environments that mediate or modify individual functioning" (p. 7).

Every life course is characterised by a course of events that gives shape to life stages, transitions and turning points. I found the focus on life events useful as it helped me to connect and study the ordering of life events and relate them to the way trajectories unfold; key events can act as 'triggers' and this allowed me to link events to transitions in later stages of the life course. Elder (1994) emphasised even though researchers tend to consider a full life course, analysis is always sensitive to the "consequences of early transitions for later experiences and events" (p. 5). Kok

(2007) concurred that the life course approach and its “methodological translation in event history analysis promises a shift from the study of simplified single events to the study of *processes*” (p. 207, original emphasis). The focus on events in a life course is not done in a disjointed way; rather these events viewed over the life course allowed me to ascribe social meaning very differently. How these life events emerge, how they are recognised and how people adapt to life events is also crucial as the same event or transition followed by different adaptations can lead to different trajectories. This also shows how transitions can modify life trajectories, where turning points denote a substantial change in direction of life course (Elder, 1994; Sampson & Laub, 1990; Elder et al., 2003; Kok, 2007). Thus the life course tradition offers specific constructs that are useful in the study of learning and work transitions.

The construct of turning points is useful in this study, and Hodkinson and Sparkes (1997) who were writing from career turning points perspectives, helped me to expand this theoretical construct. They outlined three main types of turning points – structural, self-initiated and forced. **Structural** turning points are the result of external structures of institutions. An example of a structural change comes at the end of compulsory schooling, or the compulsory retirement age. **Self-initiated** turning points occur when the person concerned is instrumental in precipitating a transformation, in response to a range of factors in his/her personal life in the field. Sometimes turning points are **forced** as they can be precipitated by external events and/or the actions of others such as redundancy (ibid., p. 39).

Elder et al. (2003) stressed the importance of clarifying terms that some people use in conjunction with life course; these include life span, life cycle, life history and life trajectory. They emphasised that researchers should be wary of conflating these terms. Their *Handbook on Life-Course* (2003, p. 4) defined the terms as follows:

- **Life span** – specifies temporal scope of inquiry, extends over substantial portion of life, links behaviours in two or more life stages
- **Life history** – chronology of events and activities across the life course, allows the examination of life trajectories along multiple stages of life
- **Life cycle** – sequence of events

Life course theorists have synthesised some key ideas of the paradigm into some fundamental principles. I will start by discussing five of the fundamental principles that guide life course work and that provide useful theoretical vantage points for research:

- **The principle of life span development** – emphasises the need to take a long-term perspective and study lives over a substantial period of time. This alerts us to the idea that we can only really understand behaviours by taking into account experiences in earlier life (Elder et al., 2003, p. 11; Kok, 2007).
- **The principle of agency** – people construct their life course through the choices and actions they take within the constraints and opportunities that they face. This principle acknowledges that we are not passively acted on by social structure and institutions; we make choices and compromises according to how we perceive them. Choice-making has a significant impact on trajectories (ibid.).
- **Time and place** – an individual's life course is embedded and shaped by the time and places that they have encountered. This highlights the importance of a researcher paying attention to the interactions of the life course with the temporal and local contexts (Kok, 2007). Elder (1994) also highlighted historical worlds and historical effects and encouraged researchers to look out for the period effect history can have which can sometimes be seen across a birth cohort.
- **Timing** – consequences of life transitions events and behavioural patterns vary according to timing in a person's life. The same event may affect different people in different ways depending on when they occur in the life course (Elder, 1994, Kok, 2007).
- **Linked lives** – people live their lives interdependently – this acknowledges the network of shared relationships we face in our life-course (family; co-workers; friends).

Researchers tend to talk about life course research in two ways: 'object-view' and 'paradigm-view' (George, 2003; Shanahan & Macmillan, 2008). The work of Elder (1994) outlined above could be regarded as 'object-view'. George (2003) argued that the future of life course research lies with an "integration of life course principles with the total range of theoretical and substantive themes" (p. 673), which indicates more of a 'paradigm-view' of the life course approach and reflects a more interconnected approach to using life course. This is largely how the ideas were used in this study to explore the career stories presented in Chapters 7 and 8. The career stories needed to be viewed across a life span; this provided one layer of meaning to developing an understanding of the learning pathways.

4.4.2.3.1. *Challenges with life course*

Kok (2007) drew our attention to the idea that the elevating of a socially determined trajectory leads to an 'oversocialised' image of individuals. Fenwick (2013) critiqued the 'overfocus' on a

trajectory of “linear chronological change” (p. 8), which she saw as located within an individual and an individual life-path. She also critiqued the focus on events, which she claimed could “flatten the complexity of social relation” (p. 8), reducing multi-faceted processes to single events as they appear to one individual.

Fenwick (2013) also critiqued the humanist idea of a “self-determined, agentic subject” (p. 8) and claimed that the life course approach fails to deconstruct “cultural discourses and infrastructures constituting the narratives” (p. 8). Also lacking is the ability of this research to examine “systemic influences on and outcomes of their actions which individuals tend to disregard in their everyday practices” (p. 8).

These critiques are shared by critical realism’s commitment to a stratified ontology (Sayer, 2000) and Bhaskar’s (1993) transformative model of social action (TMSA). Bhaskar’s view of agency as being ‘embodied *agentive* agency’ that is emergent in open systems has been useful to this study to mitigate these critiques.

4.4.2.4. *Career passages*

Perspectives on career transitions are very useful within a study focused on how people are transitioning within occupations; they provide explanatory tools to explore transition into work and the transitions that shape ongoing occupational progression. Sawchuk and Taylor (2010), as well as Fenwick (2013), illustrated the large body of work that has emerged related to career management and supporting career transitions from one stage to the next. Most of these, they argued, assume that these transitions are difficult and stressful; hence we have seen a myriad of programmes to support these transitions – induction, mentoring and preparation for transition.

Another area of work relevant to this discipline is the change management industry, which supports employees through organisational change. For example, the three stage model of Bridges (2004) for managing transitions is extremely popular in organisational work. Although presented as three stages, the model is meant to reflect a process (Bridges, 2004, as discussed in Fenwick 2013):

Stage one – transition starts with an ending, ... change, transition or a new phase in career or life does not emerge until something ends, voluntarily or involuntarily;

Stage two – a transition involves a middle period termed a ‘neutral zone’, where decisions and choices are made and actions taken but where a new direction or phase is not clearly settled or habitual;

Stage three – new beginnings emerge to complete the transition, gradually replacing the connections, roles, and identities of the former period.

(Burns, 2010; Fenwick, 2013)

The journey or career pathway dominates this research area and Fenwick (2013) critiqued this as focusing on the individual professional transitioning across space and time. The systemic elements in which this person operates are perceived and represented as static and stable. She also argued that there is a focus on a relatively linear developmental trajectory in relation to institutional pathways. The transitions then are turning points, milestones or critical events. Fenwick acknowledged that there has been some attempt to broaden this focus with the emergence of career approaches such as boundaryless careers as well as protean careers. These areas of transition research will be explored in further detail below.

4.4.2.5 Making sense of the career theory terrain

Inherently, a career is different from a job as careers are regarded as the “evolving sequence of a person’s work experiences over time” (Arthur & Rousseau, 1996, p. 150). Whereas careers require upfront time in skills and experiences acquired over time, relationships and opportunities, jobs discourses do not. Sullivan and Baruch (2009) in their meta-review of contemporary career theories defined a career as “an individual’s work-related and other relevant experiences both inside and outside of organisations, that form a unique pattern over the individual’s life span” (p. 1543).

These definitions are similar in that they emphasise that a career is not a ‘momentary thing’; it involves time, continuity and change (Inkson, 2007). Understanding careers would mean focusing beyond experiences and events and exploring what came before and how this past relates to the present (ibid.). Inkson (2007) further highlighted the use of the term ‘experiences’; these would include paid work experiences but is much broader and recognises that several other experiences (parenting; hobbies) can contribute to career skills. These ideas are very useful in this study as they recognise physical movement (levels, jobs, employers, occupations and even industries); individuals and their perception of career events, and the outcomes (ibid.).

Inkson (2007) warned that it is important that we do not look at careers as being about people’s experiences in their jobs as this would be an oversimplification. He noted that careers are affected by many factors beyond the job itself, so to understand careers we need to understand wider, economic and labour market factors, social factors, organisational factors, technological factors. In this study I would add political factors and environmental change. Sullivan and Baruch (2009)

highlighted that globalisation, environmental change, rapid technological progress, increasing projectification of work, out-sourcing and part-time employment have all raised challenges for these traditional conceptions, and these factors are creating changes in how individuals make choices and enact their careers within a transitioning society (p.?). The neo-liberalist framing of education in South Africa can also be regarded as an important factor influencing career trajectories (Allais, 2003).

Sullivan and Baruch (2009) highlighted further that traditional careers were typically defined in terms of an individual's relationship with an employer. Several authors have reflected on the dominance of organisational careers through the mid-1980s (Arthur & Rousseau, 1996). Organisational careers were seen to unfold in a single employment setting. The employer-employee relationship was central to the idea that workers exchanged loyalty for job security (Sullivan & Baruch, 2009).

In the section below I will explore some of the broadening constructs used within career research work.

4.4.2.5.1 Protean career

Drawing inspiration from the Greek god Proteus, who could change his shape at will, the protean careerist is able to repackage his or her knowledge, skills and abilities to fit the changing needs of the environment in order to remain marketable (Sullivan & Baruch, 2009). Hence the protean careerist is someone who is flexible, values freedom and believes in continuous learning. A distinguishing feature of this orientation was that the individual, not the organisation, was in control of the career. Briscoe and Hall (2006, p. 6) described two distinguishing features of the protean career concept:

- It is value-driven – the person's internal values provide the guidance and measure of success;
- It is a self-directed form of personal career management.

4.4.2.5.2 Boundaryless career

This concept has been prominent in career literature since 1996 and is currently an influential construct within the framing of modern careers. Boundaryless careers evolved out of a need to respond to the growing inadequacy of the constructs framed by stable organisational careers. Roper, Ganesh and Inkson (2010) highlighted that in contexts where organisations need increasing flexibility and assume less responsibility for employees' careers, boundaryless careers offer more

useful prospects of how we can frame and start to plan careers as they represent “sequences of opportunities that go beyond the boundaries of single employment settings” (DeFillippi & Arthur, 1996, p. 116).

A boundaryless career will transcend the boundary of a single path within the boundary of a single employer. This essentially results in a career that has many employers, through changes in jobs, occupations or careers, which gains its meaning from outside the employer through external networks, or interpretation of the career as independent of the organisation (Arthur & Rousseau, 1996, p. 6; Baruch, 2006). Baruch (2006) synthesised these ideas into this clear statement: “people have a variety of career options and paths and they navigate their careers rather than letting the organisations decide for them” (p. 128).

Arthur and Rousseau (1996, pp. 6-7), originators of the term ‘boundaryless career’ noted six aspects of it:

- Movement across the boundaries of separate employers;
- Draw validation from outside the present employer;
- Sustained by networks and information external to current employer;
- Break traditional organisational career boundaries;
- Reject traditional career opportunities for personal or family reasons; and
- Perceive a boundaryless future regardless of structural constraints.

Fenwick (2006) discussed two important elements of boundaryless work relevant to this study. She explained that boundaryless work involves a sense of specialised expertise being developed and offered which would mean that the career is marked by the development of specialised portable skills, knowledge and abilities. The second element is job mobility across multiple employers, erasing conventional boundaries defining job, workplace and employer. Other authors have added other elements that characterise boundaryless work; personal identification with meaningful work; on the job action learning; development of multiple learning and peer learning relationships; individual responsibility for career management (Ensher, Murphy, & Sullivan, 2002; Arthur & Rousseau, 1996).

The importance of physical mobility is also highlighted by Sullivan and Baruch (2009), who extended these ideas to emphasise that we need to distinguish the different types of mobility: voluntary or involuntary; company or self-directed; up or down. The theoretical work on mobility has played a very crucial role in conceptualising this study and in its data analysis.

Weick (1996) noted that organisations need to leverage diverse knowledge resources and to do this they need to loosen bureaucratic form and discipline (p. 42). Roper, Ganesh and Inkson (2007) developed a meta-review of 49 boundaryless career studies to determine knowledge interests. They typified four knowledge interests in these studies:

- **Managerial:** studies driven by an interest to be useful to management – boundarylessness as a managerial problem, high labour turnover due to increased mobility;
- **Agentic:** knowledge geared towards facilitating an individual's ability to make choices; focused on self-development of individual actors;
- **Curatorial:** driven by scholarly wishes; motivated by intellectual curiosity; and
- **Critical:** concern with social justice and equality.

They also found a significant number of studies with multiple knowledge interests. Although Baruch (2006) stressed that protean and boundaryless careers are distinct constructs, other theorists (Granose & Baccili, 2006, as cited in Baruch, 2006) have argued that they are relatively similar.

This study utilises the concept of boundaryless career (see Chapters 7 and 8) to explore the career stories. Gunz, Evans and Jalland (2000) argued that careers have not become boundaryless; rather career boundaries have become considerably more complex and multifaceted. But this is not the only critique levelled against this career discourse; it is largely regarded as a discourse that works with highly skilled jobs as career movement for lower skilled workers is largely intra-organisational (Roper, Ganesh, & Inkson, 2010). There is furthermore a strong focus on the mobile individual who voluntarily builds careers across boundaries. It is also critiqued for presenting boundaryless careers as only positive, neglecting to acknowledge those that struggle with adapting and those with negative career outcomes (Eby, Butts, & Lockwood, 2003). The focus on agency and rational choice has been critiqued, and some would argue that the importance of structural restrictions and how they affect career behaviour is underestimated (Forrier, Sels, & Steyn, 2009).

4.4.2.6 Career mobility a useful lens

Career mobility is an area of research closely related to transition research. In this section I will explore some dimensions of the term and its usefulness within this study. Studying the main factors determining and constraining transitions in careers will enable the development of a clearer picture of the nature of the learning pathway.

“Career mobility implies the transition from one position to another” (Forrier et al., 2009, p. 741).

Ng, Sorensen, Eby and Feldman (2007, p. 363) referred to “patterns of intra and inter organisational transitions over the course of a person’s work life”. An understanding of mobility is central to an understanding of how careers develop over time. Forrier et al. (2009) deepened these ideas on mobility and explained that career transitions can take different forms of job change, organisational change, occupational change or work role transition – any change in employment status or job content (Ng et al., 2007). The increasing number of transitions over the life course (Sawchuck & Taylor, 2010; OECD, 2008) suggests that job mobility is increasing.

Ng et al. (2007) also highlighted six specific types of mobility which Forrier et al. (2009) suggested are valuable for studying specific types of transitions:

Internal-upward – job change promotions within same organisation (leadership development programmes);

- **External-upward** – job changes that are promotions but with different employers (typically significant increase in job responsibility and hierarchical level);
- **Internal-lateral** – job changes within same organisation and at same hierarchical level;
- **External-lateral** – same level but with different employer;
- **Internal-downward** – demotions within same organisations; and
- **External-downward** – changing employer and working at lower hierarchical level.

External job mobility may occur within the same or different occupations (Forrier et al., 2009). Ng et al. (2007) provided a useful heuristic to discuss mobility. They identified three categories of factors that affect mobility. Firstly, **structural factors**, which exist on the societal, industry and organisational levels and which impact on the availability of mobility options. Then there are **individual differences**, which indicate preference for one type of mobility option over the other and lastly **decisional factors**, which reflect the individual’s intention to engage in one mobility option. The three layers cross macro and micro levels with the structural reflecting the macro structural level and the others focusing on the individual level. This resonates with the critical realist notion of laminated systems presented in Chapter 2 and strengthens the use of career theory in this study.

4.4.3 Challenging transitions – Managing transitions in transitioning times

Across Chapters 1, 2 and 3, I have outlined the social, environmental and economic challenges South Africa is contending with in its transition to democracy. Educationists such as Allais (2003) have critiqued the ushering in of neo-liberal globalisation in the transition to democracy, which

was cloaked in the scenario of high skills and global competitiveness. As discussed in Chapter 1, South Africa faces high levels of unemployment, the small growths in the economy have not resulted in greater labour absorption in the formal economy and the extent of graduate unemployment (Chapter 5) is of concern. Trying to understand how people make transitions in challenging and changing contexts is one of the intentions of this study.

Sawchuk and Taylor (2010) reflected on changing global economic contexts and articulated some implications for researching school to work transitions. They emphasised that learning and work transitions are increasingly complex, extended across life courses, and are differentiated and differentiating across social groups. They noted that transitions are increasingly fragile and exclusionary. Supporting these ideas, the Organisation for Economic Cooperation and Development (OECD, 2008) reported that the number of ‘stepping stones’ required by youth to secure a labour market position is multiplying (Sawchuk & Taylor, 2010). This observation is corroborated by the discussion presented on 600 environmental graduates in Chapter 6. They further explained that primary labour markets (good jobs) are shrinking in relation to labour market participation. Workers in primary labour markets retain the ability to positively cope with their transitions, either vertically or laterally and will probably see either stable or growing remuneration. But secondary labour market workers will experience this differently, which again raises issues of social difference and non-linearity. Within South Africa, labour market discrimination in the form of gender, race, ethnicity and disability is still a reality (see Chapter 1).

Sawchuk and Taylor (2010) mapped some ideas for a way forward for transition research. They have positioned their views as critical vocationalism focusing on learning to work transitions. Although they stressed that new vocationalism (which draws strongly from economic approaches) and critical vocationalism remain on a continuum (so as not to create two ‘camps’), their positioning is very distinct and well-defined. Sawchuk and Taylor (2010) argued that the central underpinning idea in vocationalism is that workers need to be adapted to the needs of the economy – a key idea of a new vocationalist position is the notion of human capital. They argued that the vocationalist position, which they see as primarily foregrounding an individual/adaptive perspective, has inherent difficulties in admitting structural contradictions rooted in both institutions of education and economy. Thus the reality behind the vocationalists’ propositions is that in minimising the attention on how education systems work together with labour markets and work systems, “they are shaped by the tensions, and contradictions inherent within processes of control, conflict, accommodation and occasionally resistance” (Sawchuk & Taylor, 2010, p. 9).

Thus a response within vocationalist mindset assumes that more responsive education, continuing education, vocational and workplace training (from cradle to grave), would address the problems in the economic, labour market. Similar critiques have been raised in South Africa as discussed in Chapter 2 (Section 2.3.2.2) where the emergent NQF and outcomes based education were seen as key mechanisms to address the huge social and economic issues post-apartheid. However, as illustrated by Livingstone (2004) and Sawchuk and Taylor (2010), this remains a flawed thesis, as a significant 'education-jobs' gap remains under-recognised and misinterpreted within the new vocationalist position (Sawchuk & Taylor, 2010, p. 9). These perspectives have much synergy with current issues in South Africa as has been introduced in Chapter 1 and will be further explored in Chapter 6.

Critical vocationalism has its theoretical roots in areas of work concerned with race, disability, social class, gender and represents a school of thought intended to disrupt the status quo. Central to the critical vocationalist perspective is an understanding of context, social differences and power relations that "define how learning capacities are productive and reproductive of uneven social and economic prosperity" (Sawchuk & Taylor, 2010); these need to be emphasised in transition work. Bynner (2001), as cited by Sawchuk and Taylor (2010), in reflecting on transitions, highlighted the "interconnectedness of activity across the different domains of life"; he further emphasised that there is a lack of attention on the broader political climate, culture and the effects of other spheres of institutional and non-institutional life as dimensions of the transition process (which I address in Chapters 1, 3, 5 and 9).

Sawchuk and Taylor (2010) argued that many critical approaches remain fixated on the distribution of education and training generally, ignoring different social groups, and focusing simply on job attainment rather than the quality of the transition experiences. This forces a shift in gaze when we examine transitions to highlight the variety of social variables that shape patterns of transitions. These ideas resonate very strongly in a study on learning pathways and have enabled me to acknowledge that educational pathways are not neutral mechanisms for allocating opportunities to people. The learning and work transitioning lens enabled me to dissect learning pathways as opportunity structures. The critical realist work in this study enabled a focus on the generative mechanisms shaping learning to work transitions and the opportunities for transformative praxis (see Chapters 7 and 8).

In addition to calling for more attention to social variables, Sawchuk and Taylor (2010) argued for

an expanded view of transitions that encompass inter-institutional that focused on formal and non-formal learning experiences within learning and work transitioning, as well as intra-institutional transitions that are focused on transitioning into different types of work, sectors and occupations. This study's focus on transitioning into an emerging specialism within an organised profession (see Chapter 7) and the focus (in Chapter 8) on an occupation with widely changing and undefined parameters will thus make a contribution to expanding insight into learning and work transitions. The critical intent of the study to highlight structural contradictions in the educational systems supporting green skills also resonates within the wider framework of critical vocationalism as proposed by Sawchuk and Taylor.

Sawchuk and Taylor (2010) argued that an important theme in critical vocationalism is informal dimensions of transitions, learning and experience, which are useful in a study on environmental learning pathways. They claimed that to understand the range of complexity of learning and work transitioning throughout the life course, we need to recognise "learning and experience throughout its full range of variation" (p. 1), which they posited is absent from dominant theoretical and policy based research. The neglect of informal learning, they contend, is due to the difficulty to credit and commodify it. The critical vocationalist approach helps to highlight these barriers and their impact on individuals and groups.

4.4.3.1. Looking at macro frameworks for understanding transitions

Raffe (2008) provided a useful frame for helping to develop an understanding of the macro aspects of transitions, which he outlined as different institutional and structural arrangements that shape young people's education-work transitions. His heuristic of a transition system (synthesised into Figure 4.2) provided a useful overview for this study; it enabled me to identify components that require attention and it provided a useful way to conceptualise the notion of a 'transition system' as a multi-dimensional concept, that involves strong interdependent relationships between education and labour market and societal, historic and political factors. It helps us to understand the components within institutional arrangements and how they can impact and shape transition processes and outcomes. Although this is not a national study, reflecting on national transition patterns with an intention to be comparative as used by Raffe, this framework was useful in highlighting transition variables (see Figure 4.2).

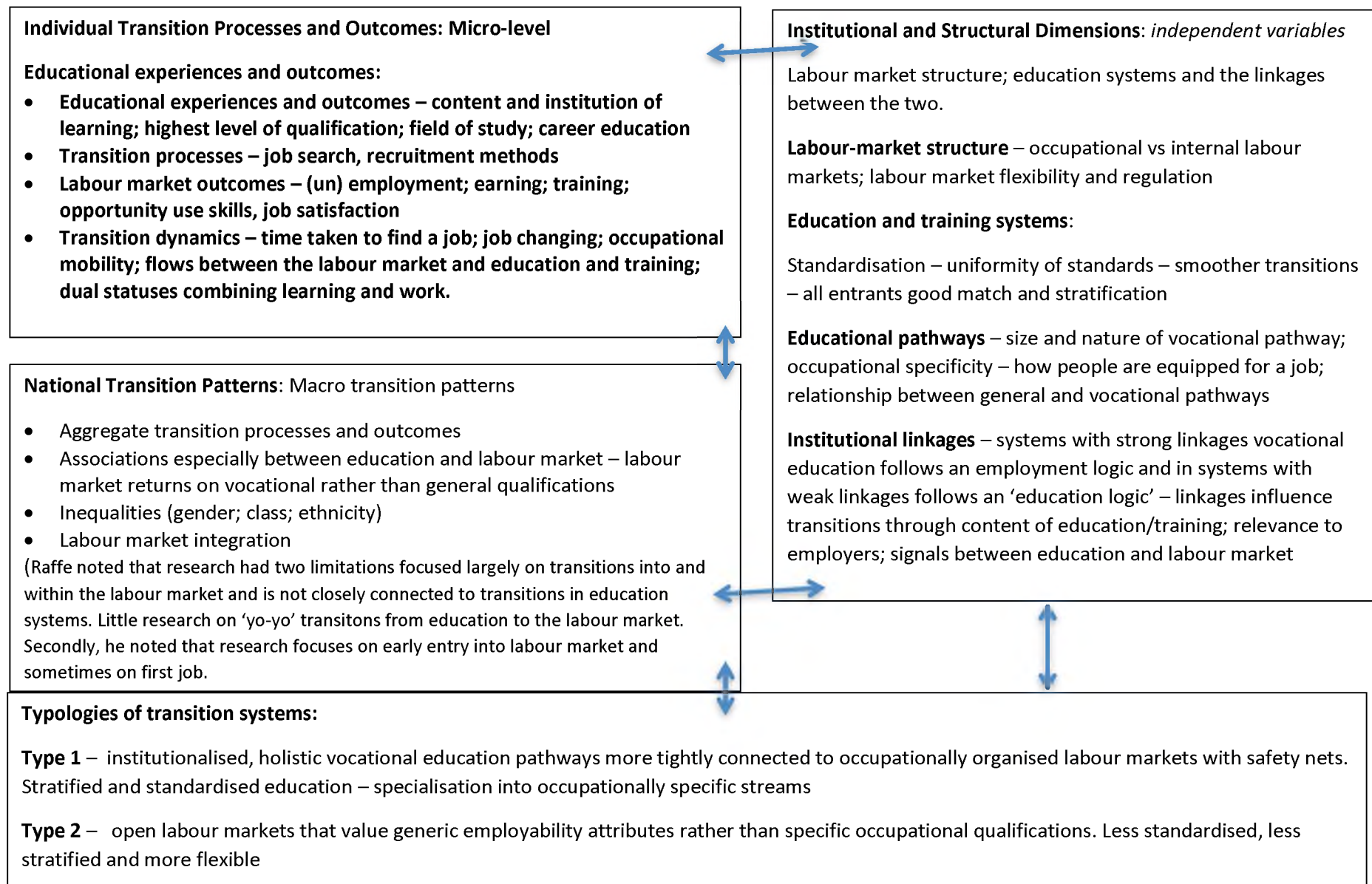


Figure 4.2: Macro framework summarised from David Raffe (2008) - a synthesis of Raffe’s conceptual framework of transition systems

The OECD (2000) also highlights six key ingredients of an effective transition system:

- A healthy economy;
- Well organised pathways that connect initial education with work and further study;
- Widespread opportunities to combine workplace experience with education;
- Tightly knit safety nets for those at risk;
- Good information and guidance; and
- Effective institutions and processes.

These characteristics are inherently framed within a vocationalist perspective of education preparing people for the labour market. These six characteristics have been useful to develop my critical analysis of the provisioning for green skills that is presented in Chapter 6. Wheelan et al. (2012) reflected that despite the **theoretical eclecticism** that Raffe highlighted within transition research, the macro perspectives presented by these two macro frameworks help to understand characteristics of transition systems, patterns of transitions and logic of the transition system. It further helps to understand how the structure of social institutions impact on transitions, which in turn provides insight into the nature of social change and helps to frame implications for policy. These macro frameworks provide this study with a vantage point that allowed me to view how the structure of social institutions can impact on transitions and enabled a clearer view of the nature of institutional changes and hence has implications for reflecting on educational policy and the systems of provisioning. Through this, the study will make a contribution to exploring how transitioning systems respond to new areas of work as envisaged by the transition to the green economy. However, these frameworks do not assist with raising structural contradictions in the education system nor do they pay sufficient attention to historical, political and social factors shaping learning and work transitioning. I have addressed this by drawing on the Sawchuck and Taylor perspectives discussed above and the critical realist perspectives underlabouring this study (see Chapter 2). Furthermore, the positioning of this study in the critical research domain, within a transformative intent is another strategy for addressing these constraints.

4.4.3.1 A closer look at the informal learning dimension in transitions

Fundamental to understanding educational and occupational transitions is understanding the learning underpinning these processes. Field (2012) emphasised that transitions are an important focus for adult learning. Gallacher, Ingram and Field (2009) also referred to transitions between different forms of learning and Glastra, Hake and Schedler (2004) supported this view by stressing that all lifelong learning is transitional learning. All learning implies the integration of two very

different processes, namely an external interaction process between the learner and his or her social, cultural or material environment, and an internal psychological process of elaboration and acquisition (Illeris, 2009, p. 8).

In this section I will explore some theoretical constructs on learning that help to make sense of the learning transition relation. The need to broaden views of learning beyond the formal has been a long-time focus of educational discussions. Although I support the view of Colley, Hodkinson and Malcolm (2003) that formality and informality in learning should be viewed as a relational continuum, I consider it useful to explore some typologies that are used in the literature to understand the relationship between these elements of learning. I draw on somewhat related typologies to help me make meaning of these learning relationships in this study.

The first typology outlined is from the European Commission (EU) (2001). Although not purposefully theoretical, its intent was to guide EU educational policies, projects and programmes. It still represents a powerful construct and has influenced conceptualising within EU countries.

EU's three-fold definition of learning: **formal learning** (i.e. learning that occurs in a structured context and that results in nationally recognised qualifications); **non-formal learning** (i.e. learning that is embedded in planned activities that are not explicitly designated as learning) and **informal learning** (i.e. learning that arises from daily life experiences, that traditionally does not lead to certification but may be subject to some form of accreditation/recognition. (European Commission as cited in Colley et al., 2003)

Sawchuk (2008), commenting on work done in Canada, drew on Livingstone's (2005) conceptualisation of formal and informal learning:

When a teacher has the authority to determine that people designated as requiring knowledge effectively learn a curriculum taken from a pre-established body of knowledge, the form of learning is **formal education**, whether in the form of age-graded and bureaucratic modern school systems or elders initiating youths into traditional bodies of knowledge. When learners opt to acquire further knowledge or skill by studying voluntarily with a teacher who assists their self-determined interests by using an organized curriculum, as is the case in many adult education courses and workshops, the form of learning is **non-formal education or further education**. When teachers or mentors take responsibility for instructing others without sustained reference to an intentionally-organized body of knowledge in more incidental and spontaneous learning situations, such as guiding them in acquiring job skills or in community development activities, the form of learning is **informal education or informal training**. Finally, all other forms of intentional or tacit learning in which we engage either individually or collectively without direct reliance on a teacher or an externally-organized curriculum can be **termed self-directed or collective informal learning**. In the most expansive conceptions of human learning, self-directed learning may be seen as coterminous with life experience itself. (my emphasis, Livingstone, 2005, as cited by Sawchuk, 2008, p.5)

This rather long but useful elaboration forefronts issues of agency, and helps us to recognise that mediation of learning involves knowledge and skill artifacts (Sawchuk, 2008) as well as values.

These learning artifacts can be expressed through dominant institutional structures (curricula, policy, teacher authority), while other forms could express cultural forms, content, habitus, language codes (Sawchuk, 2008). This discussion places an emphasis on knowledge form or knowledge structure, which is distinguished as either pre-established or situational.

Eraut (2000) classified learning into formal and non-formal learning. He outlined the following characteristics of formal learning (implying that any other learning is non-formal):

- A prescribed learning framework;
- An organised learning event or package;
- The presence of a designated teacher or trainer;
- The award of a qualification or credit; and
- The external specification of outcomes.

He deepened his conceptualisation of non-formal learning in a later framework (2004) in which he outlined a more comprehensive understating of informal learning. Table 4.1 below is extracted from Eraut (2004, p. 250).

Table 4.1: A typology of informal learning (Eraut, 2004, p. 250)

Time of focus	Implicit learning	Reactive learning	Deliberative learning
Past episode(s)	Implicit linkage of past memories with current experience	Brief near-spontaneous <i>reflection</i> on past episodes, events, incidents, experiences	<i>Discussion</i> and <i>review</i> of past actions, communications, events, experiences
Current experience	A selection from experience enters episodic memory	<i>Noting</i> facts, ideas, opinions, impressions; <i>asking</i> questions; <i>observing</i> effects of actions	<i>Engagement</i> in decision making, problem solving, planned informal learning
Future behaviour	Unconscious expectations	<i>Recognition</i> of possible future learning opportunities	<i>Planning</i> learning opportunities; <i>rehearsing</i> for future events

All three of the above typologies provide insight into elements that need to be considered when thinking about forms of learning that may be involved in transitioning. The typologies can therefore broaden the view that learning and work transitioning involves transitioning into and out of formal learning only.

However, Billet (2004) and Colley et al. (2003) offered a critique for this categorisation of learning. Billet (2004) explained that you cannot describe a phenomenon by what it is not (e.g. informal – not formalised; unstructured – not structured; planned practice – unplanned practices); approaching concepts this way does not help us to understand their qualities and characteristics. He further critiqued that these typologies set up learning and teaching as synonymous or at least linked – therefore the absence of a qualified teacher would mean that learning that does not take place in educational institutions. Writing from the perspective of learning in and through work, Billet objected to what he termed as the privileging of the practices of educational institutions (curricula, teachers, planned practice). He then raised the concern that within this frame of thinking, learning through work can be deemed as “weak, ad hoc, concrete and incidental” (2002, p. 3).

The theoretical limitation in the research work discussed thus far is the dominance of an actualist ontology (focus on experiences and events) which means that causal laws are defined in terms of empirical regularities – this can be seen in large scale tracer studies on transition work. In open systems, constant conjunctions cannot be a necessary condition for causal law (Hartwig, 2007, Cruickshank, 2003; Sayer, 2000). The learning and work transitioning research enabled me to develop descriptions of events, turning points and experiences. I required additional conceptual tools to explain the events and to explore learning pathways as a social phenomenon. Hence the role of critical realism as the underlabourer in this study as explained in Chapter 2.

4.5 Critical realism

In Chapter 2 I introduced the critical realist ontology that underlabours this study and explained some of the key critical realist constructs that have been used across this study. The discussion below introduces the use of a critical realist lens to understand the absences that denote a relationship away from being; this allowed me to conceptualise absence as central to the real and hence to being (Lotz-Sisitka & Ramsarup, 2012b; Bhaskar, 1993). I draw on absence as the primary category of dialectical critical realism as the conceptual tool in Chapter 9. Thus Chapter 9 sets out to investigate the deep-seated absences and the dialectical process of change that a focus on absence can enable. This prioritises absence as a central concept in being and implies that presence is inherently part of absence, hence giving primacy to absence.

4.5.1 A focus on absence

Deconstructing the idea of the ontologically real has meant understanding the layers of reality underpinning and generating actual events and other phenomena of the pathways, reflected as career stories. Through a critical realist lens I have begun to develop a sense of what is absent from the actual and the experienced: “What is not seen and not understood operates to destabilise what appears fixed and present to consciousness” (Norrie, 2010). Bhaskar (1993) argued that change must be conceptualised in terms of absence as absence is ontologically prior to presence, which means that any world capable of change contains absences, and agency can thus be viewed as an act of absencing (Shipway, 2010, p. 96; Bhaskar, 1993, p. 240).

Shipway (2010, p. 94) outlined that existence of an absence of an entity (including structures, mechanisms, events, experiences) could occur at any level or any region – the entity could be absent from the region as:

- Never anywhere – does not exist;
- Sometimes someplace else – finite existence;
- Spatio-temporally distant – means it was away for now. (Bhaskar, 1993, pp. 38-39)

Bhaskar (1993) recommended identifying *absences*, as both real absences (things that are simply not there, e.g. the training programmes that would facilitate learning pathways for elementary occupation workers), through real possibility (e.g. exploring how it might be possible to support learning pathways through relevant training on the NQF) and then realising these in practical terms via agency (i.e. actually implementing the possible training, once conceptualised). Bhaskar called this dialectical process “the pulse of freedom” and he claimed that it is *in the process of enabling the transformative praxis* from an unwanted situation to a wanted situation, that freedom emerges. Bhaskar (1993) and Norrie (2010) explained further that the identification of absence at the heart of the real recognises its unfinishedness, its openness to the new and its sense of mobility.

Absence therefore becomes a way of beginning to conceptualise what Bhaskar (1993) termed ‘eudemonia’, or a better society as is also envisaged by the NQF objectives (South Africa. 2008a). It becomes an opening for mapping reflexive forms of practice that can be considered transformative, without being over-idealistic or instrumentalist, for which transformative praxis has often been critiqued (Lotz-Sisitka & Price, 2015).

4.5.2 Bhaskar's dialectical method

Bhaskar (2010, p. 13) noted that dialectical critical realism is a “deepening of ontology as it involves an extension of the understanding of being”; and encompasses ‘becoming’. It does this by including negativity or non-being, in the form of the ‘determinate absence’ into an understanding of, and elaboration of:

- Being as such, and as structured, absence as product (simple absence, real determinate absence) (1M) [learning pathways as structured by sub-systems of the NQF and their formation and functioning (e.g. use of communication codes and self-reproductive tendencies); and other generative mechanisms; and absences (e.g. learning pathway options that don't exist];
- Being as process; absence as a process (simple absenting) (2E) [what needs to be there and how it can come into being];
- Being as a whole (3L); absence as process-in-product [what is possible]; and
- Being as incorporating transformative practice (agency) 4D; absence as product-in-process [what is / has been done by agents to change the situation].

Roberts (2001) elaborated that within the dialectic Bhaskar tried to explain that the complex layered nature of the world implies that “each causal power is implicitly emergent from, and partially defined by, its relationship to another causal power. In this way each causal power is defined, in part, by its ‘absence’, by its not yet known relationship to another causal power” (p.669). Thus by theorising absence, we gain a sense of the complex totality (Roberts, 2001) and a more comprehensive notion of ‘causal totality’ (Hartwig, 2007). For learning pathways research, this means that ‘determinate absences’ are or may be *as significant* to the learning pathway as that which already exists in the learning pathway. For example, the ‘determinate absence’ of successful ABET education can determine the ‘being’ and ‘becoming’ (or absence thereof) of a worker in terms of their learning pathway in substantive ways (Lotz-Sisitka & Ramsarup, 2012b, drawing on data from Monaheng, 2012).

Dialectical development of critical realism integrates an account of ‘becoming’ with an account of ‘being’. This is constituted through Bhaskar's (1993) dialectic which has four terms: non-identity, negativity, totality, and praxis (agency). His usage of these terms is radically different to Hegel's, because of his emphasis on ontology (Hegel's emphasis is more on epistemology, and emphasises only identity, negativity and totality) (Norrie, 2010). Norrie (2010, pp. 12-13) described Bhaskar's dialectic as follows (cited and slightly adapted from Lotz-Sisitka & Ramsarup, 2012b):

- **First moment (1M) – Non-Identity:** The sheer, real difference that exists in the world; associated with the ‘stratification and differentiation of the world’ (Bhaskar, 1993, p. 392), human experience as a small part of ‘what is’ – domain of the real more extensive than an empiricist concept of ontology allows with “real causes and generative mechanisms” (Price, 2007). This refers to the possibility for real differentiation in the world (not a generic, necessarily abstract, sense of difference as used in post-structuralism) (or a differentiation that lacks human agency). For learning pathways research, we may identify real causes and structural mechanisms, as well as environment-system relations and process formations influencing learning pathways at 1M.
- **Second edge (2E) – Negativity:** Real negativity and contradiction, disclosed by things in the world; the idea of real, determinate absence that exists in things, as part of what is called ‘natural necessity’. Bhaskar described this as follows:

An entity may be absent from its spatio-temporal ... region either because it is in some other region ... or because it does not exist at all ... either because it is finite and has perished ... or because it never did exist ... (whether it will or may come to exist or not). And the absence of such an entity ... may precisely, qua absence, have causal effects on objects in the relevant space-time region, and as such satisfy the causal criterion for ascribing reality to things ... Think of ... the monsoon that doesn’t come which makes the crops perish ... [the bursary that is not awarded that affects the life chances of a science graduate ...]. (Bhaskar, 1991, cited in Norrie, 2010, p. 14)

This, according to Norrie (2010, p. 14) “asserts the philosophical need to think of both negative and positive qualities in reality)”, and points to the consequences of most research which tends to “miss the importance of the negative in a purely positive account of reality ... [which tacitly assumes that] the negative can always be analysed away in purely positive terms ... The world, including the natural world, contains absences, omissions, liabilities, just as much as presences, commissions and powers”. For learning pathways research, we may identify absences, omissions, liabilities *as well* as presences, commissions and powers at 2E. Absence is a key concept in dialectical critical realist research as dialectic, at its most complete, involves “the *absenting* of constraints on the *absenting* of *absences*, or ills” (Bhaskar, 1993, p. 396, emphasis in original). What this means is that that which is present (e.g. an ABET training programme in a workplace) is a tiny, but important “... ripple on the surface of a sea of absence” (Bhaskar, 1993, p. 396). Absences include those things that are erased, hidden, omitted, forgotten or excluded

(amongst others). “Negativity embraces the *dual* senses of the (evaluatively neutral) *absence* and the (perjorative) *ill*” (Bhaskar, 1993, p. 238, emphasis in original). The purpose of dialectical critical realist explanatory critique is to “*absent ills*” (ibid., emphasis in original). Price (2007) argued that transformation is always absencing, thus system change is a process of absencing.

- **Third level (3L) – Totality:** This negativity is located in the world at a ‘third level’ of a real, open, unfinished whole. Relating the negativity or absence as identified at 2E to ‘totality’ allows for the dialectic to be engaged. Bhaskar’s work developed a crucial link between **absence as an ontologically real**, and **absence as negation**. This “... brings out the world’s dynamic and processural quality, and establishes *change* as integral to it” (Norrie, 2010, p. 15). It is at this level that the “... **processural categories of negation, contradiction, development, becoming, emergence**” are engaged; an analysis process that revolves around the categories of ‘totality and reflexivity’ (Bhaskar, 1991, p. 126). For learning pathways research, we may identify processes of negation, contradiction, development, becoming and emergence at 3L. For example, the concept and descriptors of the green economy, or a low carbon economy may represent the ‘open, unfinished whole’ that can shape possibilities for learning pathways, even if these don’t exist in South Africa at present (they *do* elsewhere, or at least in human consciousness).
- **Transformative praxis (4D):** The capacity for practical human *agency* to change the world; intentional transformative praxis (Price, 2007) or ‘agential ethical praxis’ (Norrie, 2010, p. 15) which is borne from an account of eudemonia “as a place where the freedom of each depends on the freedom of all”; and associated universalisation of practical commitments that are based on ethical positions of “what it means to be free, and to enter into relations of solidarity with others” and the non-human world on which we depend (ibid., p. 17). In this regard, Norrie (2010) explained that

... the historical and the ethical are constellationally co-embedded in a totalising dialectic that enables them to be co-present ... ethical experience can be real and irreducible [e.g. we may recognise that choices made in providing for learning pathways have real social justice implications; or democracy implications; or environmental protection implications], and at the same time connected to and influenced by historical conditions [certain ethical practices may be more necessary at certain times in particular contexts; e.g. it may be more ethically significant to give attention to the absence of learning pathways for oppressed workers in South Africa; and to pursue the possibilities for job creation under a Green Economy at this time in history for good reason]. (pp. 17-18)

This framework (also named the MELD) in Bhaskar's (1993) work allows for analysis of learning pathways in a uniquely different way to that made possible through positivism or hermeneutic research. Bhaskar's work allows us to analyse change in learning pathways in terms of "... a process of movement in which a thing becomes something else, and in that process ceases to be what it was" (ibid.). This can be the learner on the learning pathway; or the system of learning pathways provisioning; or both as they change in relation to each other. This is what ties 'being to becoming'. "Becoming is the absenting of what was in favour of the emergence of what now is, for every becoming is also, in some part at least, a 'begoining', an absenting of what was there" (Norrie, 2010, p. 15).

As indicated above, in dialectical critical realist research, absence is a significant focus of analysis.

Mingers (2010, p. 17) explained that Bhaskar's notion of absence has four categories:

- i) Simple or ontological absence, i.e., that some thing or event that is expected does not occur or does not exist. Such absences can have a causal effect and therefore 'exist' in the same way as other things.
- ii) Absence as a verb, i.e., absenting something or negating something, e.g., draining water or removing dirt; or developing a Green Economy training programme where none existed before; or absenting an absence, e.g. removing a need or want by fulfilling it.
- iii) Developing from these are 'process-in-product' whereby a process (e.g. shopping) leads to an absence (e.g. money in the bank); applied to this study, this might mean getting new qualifications in the green economy, which could potentially lead to the absence of qualifications that reproduce effluent production in an industry.
- iv) Product-in-process whereby an entity or structure (e.g. poverty, lack of money; the QCTO) exercises its powers in producing an absence (necessities of life; relevant qualifications for sustainable development training).

We could therefore argue that identification and absenting of absences is important for democracy and social justice, as it involves ethical agency for absenting constraints on freedom. If, for example, the effective ABET programme is 'absent' in a local government training context for entry level workers, the absenting of this absence will involve an ethically constituted dialectics of agency which reduces constraints on workers' freedoms. Providing for 'absent' qualifications or occupational categories that address public good concerns in SETAs or FET colleges, can similarly be viewed as a dialectically constituted form of ethical agency that absents constraints on freedom of people to choose career options and learning pathways that address public good concerns, and so forth.

4.6 Conclusion

The chapter has outlined how the thesis has crafted a set of theoretical tools to enable a more rigorous and conceptually robust conceptualising of learning pathways. This has enabled the study to coherently deal with the critiques of learning pathway work being theoretically eclectic and actualist. The critical realist laminated system allowed me to develop an explanation with explanatory mechanisms intermeshing at different levels of reality. This resonates well as in open systems there is always a multiplicity of causes and hence multiplicity of mechanisms which helps us to deal coherently with the issue of reductionism.

The following chapter outlines how these theoretical ideas have shaped the design, methodology, data generation, data analysis and reporting of this research project.

CHAPTER 5: EXPLORING METHODOLOGICAL FRAMEWORKS

A researcher's motives for engaging with a particular study topic are never a naïve choice. The notion of researchers as value neutral observers has long been challenged and overturned. Notions of researchers being able to "bracket" personal values and prior knowledge of a substantive field are open to question and debate discarded as untenable and undesirable.

This underscores the importance of researchers indicating both the position from which they speak about the research and the approach and the methods chosen to explore the topic.

Caelli, Ray, & Mill (2003, p. 9)

5.1 Introduction

Following the discussion on the contextual, theoretical and philosophical framework discussed in Chapters 1, 2 and 3, in this chapter, I outline the conceptual thinking behind framing the research design and the research process. I explain my attempts to achieve coherence between epistemology, ontology and methodology.

To begin, it can be useful to differentiate between 'method' and 'methodology'. The term 'method' denotes a way of doing something (one thing); within this study I used methods like interviews, document analysis and database analysis. Methodology refers to the coherent group of methods that complement one another and that have the 'goodness of fit' to deliver data and findings that will reflect the research question and suit the research purpose (Quinn, 2006).

This chapter draws on the critical realist philosophy that underlaboured all research decisions, and outlines how it has shaped and guided this research and the design of the study's methodology. The chapter also introduces the case study methodology used in the research and tries to outline how I built and organised the case studies. It outlines the process of data gathering, data analysis ethics, validity and trustworthiness.

The discussion in this chapter illustrates some of the strategies this study has utilised to ensure credible and rigorous research. I describe my prolonged and continuous engagement with this particular area of research: I outline my decision-making processes, describe my engagement with critical friends and critical communities of practice as well as my attempt to maintain a reflexive research process. Alvesson and Skoldberg (2000) noted that in social science research "there is no one-way street between the researcher and the object of study, rather the two affect each other mutually and continually in the course of the research process; any idea that the object is uninfluenced by the researcher and the researcher is unaffected by the object is untenable" (p. 39).

5.2 Methodological framework

5.2.1 Critical realist research

This study had an interest in understanding learning pathway construction: How do people construct their learning pathways and how is the pathway officially conceptualised within systemic supply structures? The aim was not only to advance theoretical understanding of how learning pathways are constructed but also to develop occupational and systemic insights in order to identify areas for intervention that will ultimately improve current inadequacies in learning pathway development for environmental occupations (as introduced in Chapter 1) to support the critical intent of the study. In order to do this, it was necessary for me to identify causal processes and to develop valid explanations for their outcomes. Hence the study is strongly positioned as a critical realist study (see section 1.4.6 and section 3.4). In the section that follows I will outline how this critical realist framing has influenced the design, the process and the writing of this study.

Positivist and empiricist accounts argue that qualitative methods themselves cannot directly perceive causal relationships and thus cannot give us knowledge of causality beyond observed regularities in associations of events. This view highlights the idea that causality is essentially a matter of regularities in the data (Maxwell, 2004a; Maxwell, 2004b). Critical realists such as Bhaskar, Norrie, and others, along with Benton and Craib (2001) are “committed to the existence of a real world, which exists and acts independently of our knowledge or beliefs about it” (p. 122). As explained in section 1.4.6 and section 3.4, critical realists understand causality much more usefully as consisting not of regularities but of real (and in principle, observable) causal mechanisms and processes, which may or may not produce regularities (Maxwell, 2004a; Maxwell, 2004b).

Thus, instead of perceiving a causal law in terms of observed regularity, an observed event will be contingent upon the effects of several laws interacting. This critical realist positioning helped me to work with the notion that the real is more complex than my knowledge of it. “Observability may make us more confident about what we think exists but existence itself is not dependent on it” (Sayer, 2000, p. 12). Thus though we may be able to observe some qualifications and have some idea of green jobs and people moving into these jobs, we also need to accept that there are structures and mechanisms which may be unobservable (absent). Understanding these structures and mechanisms can create the opportunity to enable change.

Sayer (2000, 2010), Maxwell (2004a, 2004b), Pawson and Tilley (1997) have all provided insight into what a realist process orientated conception of causal explanation will entail. According to

Pawson and Tilley (1997), mechanism + context = outcome; they explain that the “relationship between causal mechanism and their effect is not fixed but contingent” (p. 69) as it depends on the context within which the mechanism operates. This means that researchers need to acknowledge context beyond a scant overview that says relationships differ in different contexts; it means that we have to acknowledge the role of mechanisms as an integral part within the causal processes and relationships. Maxwell (2004a, 2004b) and Sayer (2010) both opened up another dimension for researchers: they argued that meaning, not only behaviour, is linked to causal processes. They proposed that causes are not restricted to physical entities; they can include mental processes. Thus, the meanings, beliefs, values, and intentions held by participants are essential parts of causal mechanisms.

Central to critical realism is use of the transcendental argument. “A transcendental argument is one which takes as its premise an unconventional or undisputed description of something actual and then poses the question ‘what must be true for this to be possible?’” (Benton & Craib, 2001, p. 58). Using the phenomenon (**P**) we begin with an uncontroversial description of **P** (e.g. learning pathway of an environmental engineer, see Chapter 6). Then a researcher would ask ‘what must be the case for **P** to be possible?’; the researcher then tries to determine some condition **C** that can be identified as a necessary condition for **P**. Since we have already determined **P** to be *actual*, then it must be possible, so the conditions, which make it possible, must be satisfied. So **C** must be the case – the real interacting generative mechanisms (ibid. p. 122).

In this study I have tried to understand people’s pathways into their environmental jobs. Since they are currently working in the job there must be a pathway. The conditions that make the pathway include, amongst others, a job (labour market demand), an educational route (qualifications and courses; work experience) into the job and the conditions shaping those actual jobs e.g. environmental degradation, climate change, transitioning societies.

5.2.2 Use of case study in critical realist research

To understand a learning pathway and explore its distinctive nature I needed to study it in a specific context that could provide me with concrete, in-depth, context dependent knowledge about the construction of a learning pathway. Hence my research design decision to use case studies. Case studies represent a ‘bounded system’ or ‘individual unit’ of enquiry (Flyvberg, 2011) or may refer to several different epistemological entities. They constitute a particular way of collecting, organising, and analysing data (Patton, 2002).

The aim of a case study can be described as follows:

A case study is expected to catch the complexity of a single case. The single leaf, even a single toothpick, has unique complexities – but rarely will we care enough to submit it to case study. We study a case when it itself is of special interest. We look for the detail of interaction with its context. Case study is the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances. (Stake, 1995, p. xi)

In this study I collected data and organised it into three ‘cases’. To further deepen my investigation, I used two environmental occupations, environmental engineer (Chapter 7) and environmental scientist (Chapter 8), as my primary occupational cases. The first case study was more of an ‘epistemological entity’ and describes some of the key systemic elements supporting green learning pathways within the post-school sector (Chapter 6). Figure 5.1 below illustrates the three cases and shows how these are related to the critical realist laminated system framework introduced.

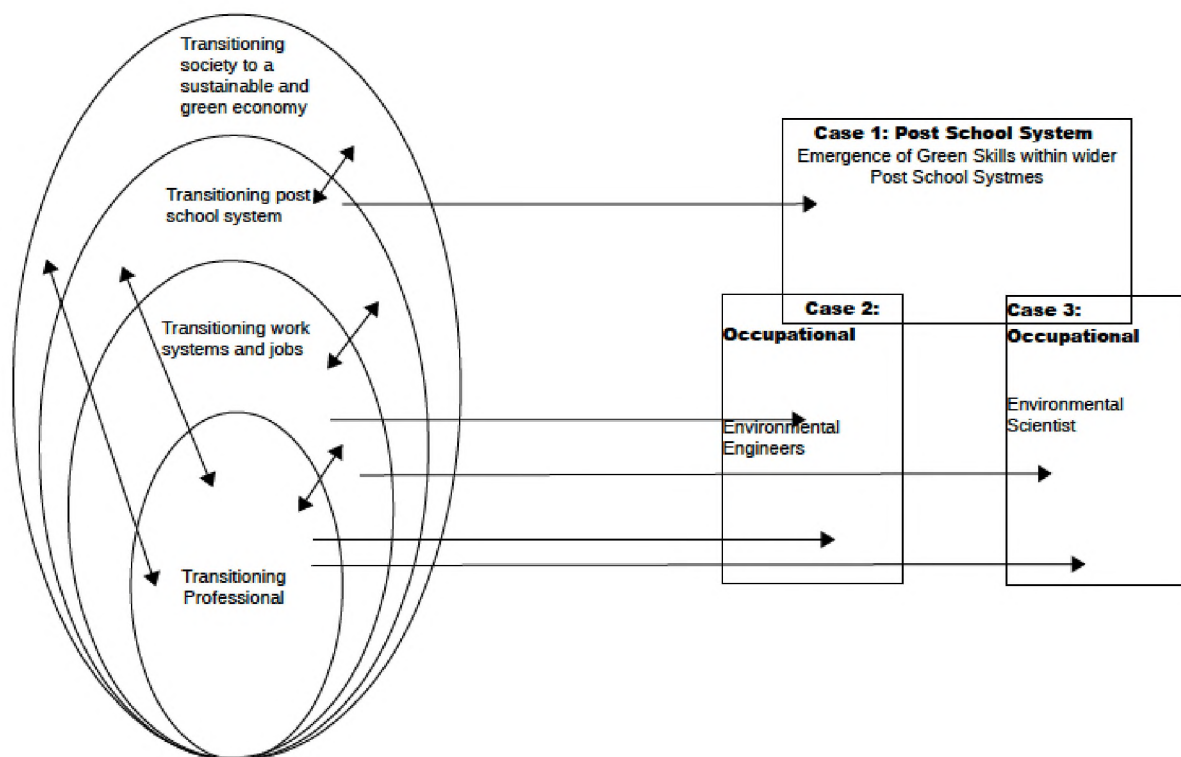


Figure 5.1: Relation between cases and laminated system framework

Sayer (2000) explained that social systems are open, complex and messy and within these open systems, the objects of social science research must be viewed as containing multiple components and forces. Social science cannot isolate components and study intensively under controlled research conditions. Figure 5.1 illustrates how the critical realist laminated system framework

allowed me to develop an explanation with explanatory mechanisms intermeshing at different levels of reality; it thus served as an effective heuristic device to enable me to work with different levels of reality so that I could develop non-reductionist laminated explanations.

5.2.3 Case studies and intensive research

Yin (2003) categorised cases as explanatory, exploratory or descriptive. He also described cases as single, holistic or multiple case studies. Bassey (1999) presented three types of cases studies: theory seeking and theory testing (instrumental), storytelling and practice drawing case studies (intrinsic) and theory generating case studies (collective).

Sayer (2000, 2010) distinguished between intensive and extensive research design which involves asking different questions, using different techniques and methods and defining objects differently. Intensive research is focused on substantial relations of connections and seeks to develop causal explanations of certain objects or events. This involves qualitative research of agents in their causal contexts as intensive research is focused on groups which are related to each other structurally or causally; thus it focuses on specific identifiable individuals related in a causal group (Sayer, 2010). Intensive studies suitable for critical realism research would, therefore, have an interest in understanding what makes things happen. Intensive studies “seek out substantial relations of connection and situate practices within wider contexts, thereby illuminating part-whole relationships” (Sayer, 2000, p. 22). Through this, they enable a researcher to create the opportunity to develop a window into the study of larger entities and to illustrate how the part is related to the whole.

A key critique of intensive case study research is the following limitation: “actual concrete patterns and contingent relations are unlikely to be representative, average or generalisable” (Sayer, 2000 p. 21). The dialectical critical realist lens in this study enabled the career stories (singular concrete instances) analysed in the study to be strengthened and more broadly interpreted, reflecting the transfactual, universal concrete mechanisms that have influenced it (the singular concrete learning pathway). The generative mechanisms which enable and constrain learning pathway development could then be more broadly interpreted and used to reflect on pathway development in the field. The principle used here is that of the concrete universal which in critical realist research recognises that in applied analysis, not only should the singular case (i.e. individual things and events) be explained in terms of “the intrication of a multiplicity of explanatory mechanisms”, but also “they must be conceived as concrete universals and singulars” (Bhaskar, 2010, p. 6). Bhaskar went on to explain that “every particular phenomenon which in

some way instantiates a universal law does so concretely” (p. 6). What Bhaskar meant by this is that analysis of a singular case as a ‘concrete universal’ allows for interpretation of the singular case not only in terms of the individually reflected or unique characteristics of the case (i.e. the individual story of a particular environmental engineer and all of the details that pertain to that story only), but that the particular case at the same time has underlying generative mechanisms (e.g. the dualism between environment and development that has led to less recognition for environment in development discourses, which in turn has affected the types of engineering qualifications on offer). These generative mechanisms can apply to the ‘universal’ or wider context, influencing a range of singular cases in similar ways. Bhaskar (2010, p. 6) explained that the generative mechanisms are relatively enduring, meaning that they have substantive effects that can last over a period of time and can impact on a range of individual or singular cases. It is at the level of the generative mechanism that one is able to draw more generalised conclusions from cases.

5.2.4 The use of case study in this study

According to Patton (2002), one should start collecting data on the lowest level of analysis possible, thus I began by collecting data about individuals’ career stories in each occupation and tried to develop a context-specific idea of how each person developed a learning pathway into their environmental jobs. I also collected information on the key aspects of supply linked to each occupation (qualifications available, defining of occupation, career systems, representation in national education and training systems). I then used each case’s data to construct the case record. By putting the parts together, I was able to discuss the learning pathway – what was present and what was absent. Figures 5.2 and 5.3 below illustrates the case development within this thesis. These figures further illustrate how the study actively gathered and analysed data at different levels of reality to enable me to deal with multiplicity of causes and hence multiplicity of mechanisms to coherently counteract issues of reductionism. Figure 5.2 illustrates Case 1; this case aimed to understand the patterns of emergence of green skills within the post-school sector. It thus provided the study with meso level data, and helped to illustrate the systemic mechanisms that come into play within the two occupational chapters.

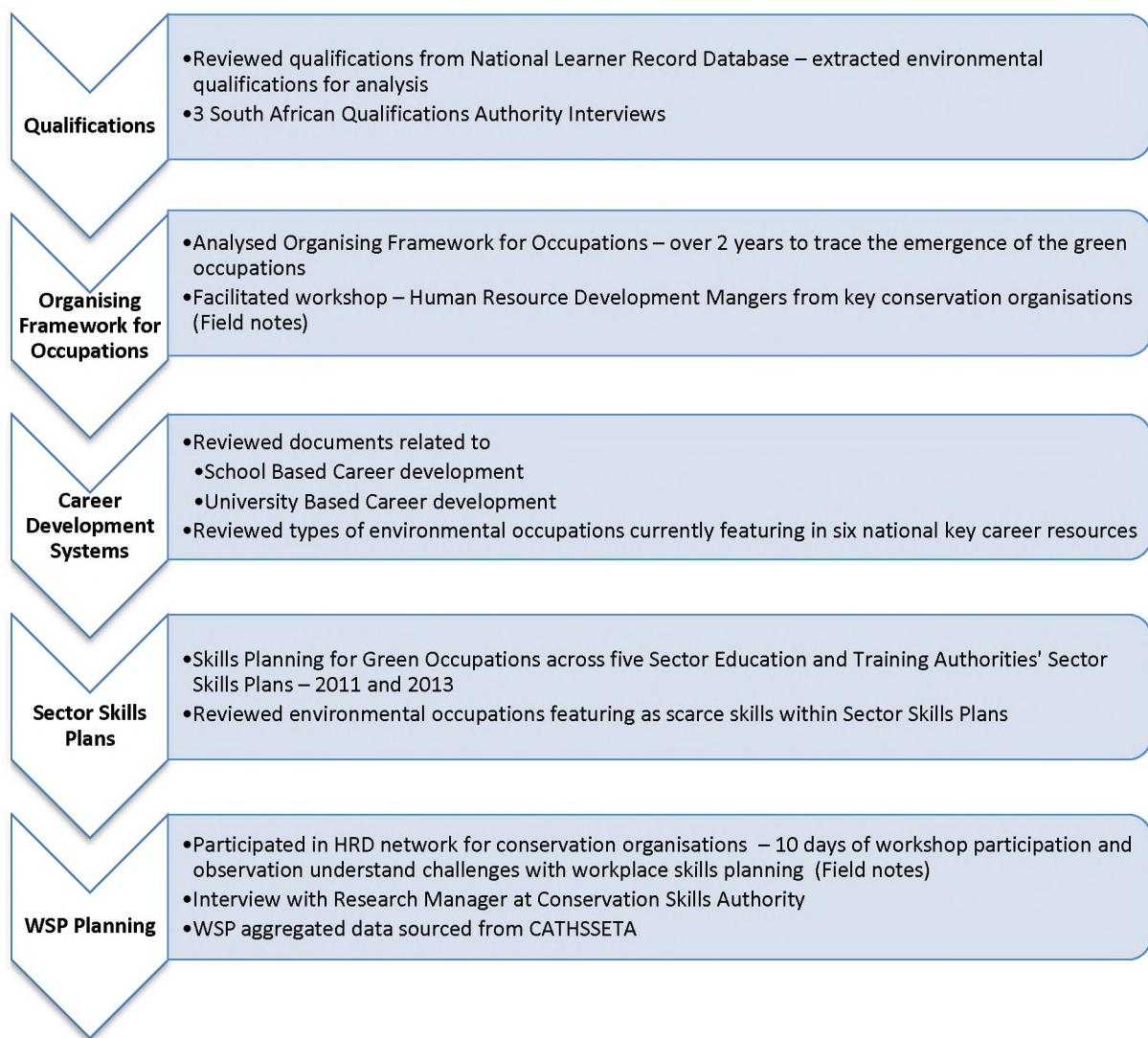


Figure 5.2: Framing the cases within a Laminated System Framework: Case 1 – The emergence of green skills within the post-school system

Figure 5.3 that follows illustrates the two occupational cases that compose Chapter 6 and Chapter 7. They depict the data collected to investigate the learning pathway of the environmental engineer; the construction of the case of the environmental scientist, which followed a similar pattern of investigation.

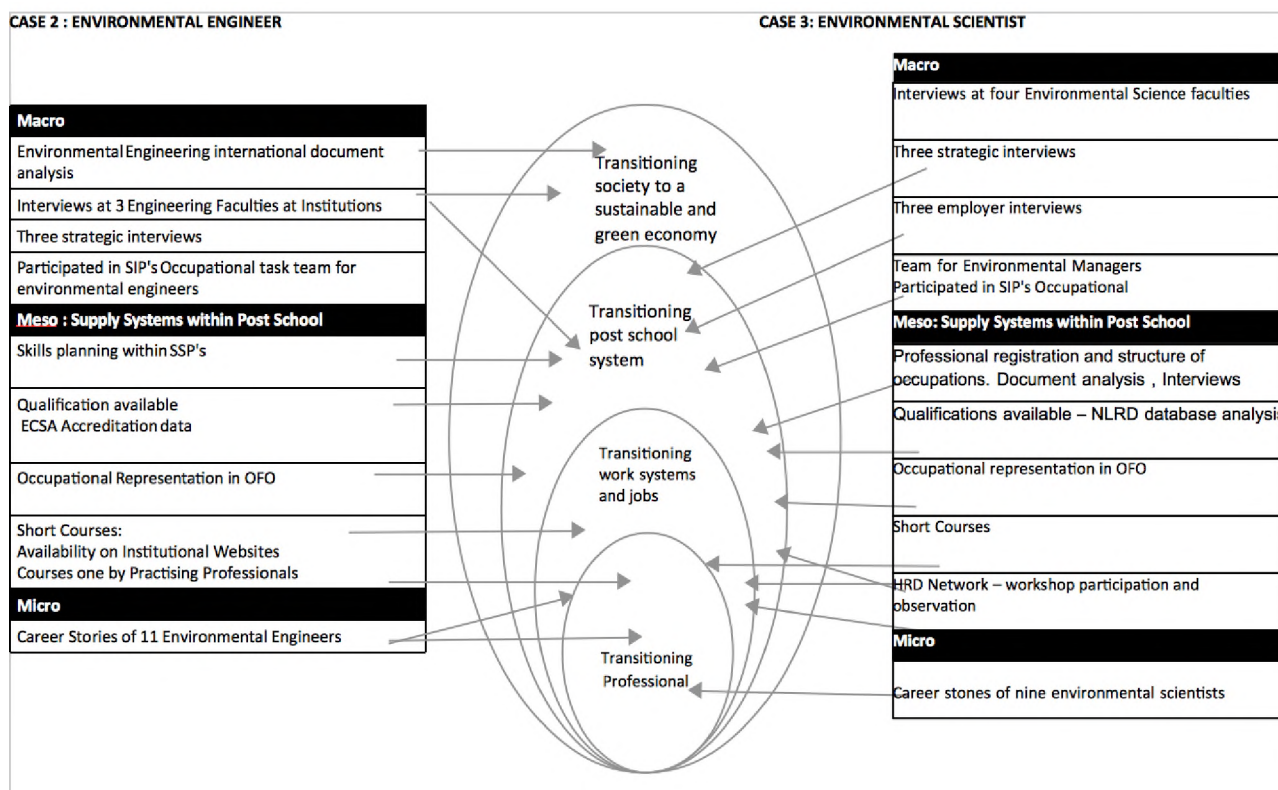


Figure 5.3: Framing the cases within a Laminated System Framework: Occupational cases

5.3 Careers as stories

Careers are inherently dynamic; they evolve, develop and intersect in planned and unplanned ways, making it problematic to utilise linear, agentic frameworks for understanding career trajectories (Cohen & Mallon, 2001). In cases 2 and 3, I was interested in using the individuals' understandings and perceptions of their pathways as a starting point to develop meaning; I opted to build the cases using career stories of practising professionals (see Chapter 6 and Chapter 7). This was a significant methodological choice and it helped considerably to frame the two occupational cases. As is explained in Chapter 5, very little systemic data on environmental occupations existed. These career stories thus formed an important framework for building my cases.

Storytelling is a fundamental human activity (Polkinghorne, 1998 as cited in Inkson, 2007) and hence stories have emerged as a major source of understanding about how careers work. As people experience things and tell stories about their career experiences they also construct their personal realities and biographies (Patton & McMahon, 2006), and it is through these constructions of reality that we are able to see patterns and relationships between wholes and parts. Hence career stories have been recognised as useful retrospective sense-making tools. The

idea of connecting events and considering the order in which things happen as a story unfolds has been discussed in detail by many career theorists (Cohen & Mallon, 2001; Patton & McMahon, 2006; Inkson, 2007). Savickas (2005) also confirmed the usefulness of story. He noted that in chronicling the recursive interplay between self and society, career stories explain why individuals make the choices they do and the private meaning that guides these choices. Stories enable the researcher to build a “rich, complex, multifaceted and integrated picture from the perspective of situated individuals” (Cohen & Mallon, 2001). Inkson (2007) noted that a story needs a theme, plot and a way of arranging the characters and through these, stories help us develop meaning and interpretations of events.

Representing careers as stories was an attempt to move the study away from viewing career moves, routes or events as ‘once-off’ and to avoid narrow “fractured understandings and reductionist perspectives” (Cohen & Mallon, 2001, p. 48) and rather support construction of a rich multi-layered picture of careers (in the case of this study, these will be newly emergent environmental careers).

Reflecting on the empirical use of stories in career research, Inkson (2007) noted that narratives involve **temporality** (how events are related in time) and **causality** (how events cause each other) but the time involved is subjective and the causality is subjective and loose, rather than rational and precise. Patton and McMahon’s (2006) work also highlighted the importance of ‘**acausality**’ (lack of linear cause-effect relationships) within career stories which is a position consistent with the critical realism focus within this research.

Cohen and Mallon (2001) showed clearly that to explain a career transition, interviewees needed to move beyond the abstract and situate the career event within a meaningful context. This context was both **temporal** (the sequence of events leading up to the decision to leave the organisation) and **social** (including the important people and events which were seen to influence the decision).

Despite the fact that stories as a research method offer authenticity, they can be critiqued for lacking orderliness, generalisability, and efficiency (Inkson, 2007) and yielding a mass of unwieldy data (Cohen & Mallon, 2001). This research will explore learning journeys of environmental / sustainable development professionals as the biographical narratives made up of interconnecting sub-stories as their ‘path or trajectory’ through our available ‘figured world’.

The use of career stories in the study enabled the following:

- Capturing the **process notion** of career formation in the sector
- Enabling a focus on the ‘human beings’ in action and on the mechanisms underlying human action. This allowed the study to bring **human agency** and the dynamic nature of career formation via structures and systems that exist or don’t exist to the fore (singular concrete in relationship to the universal concrete, after Bhaskar, 1998a)
- Capturing the **relational and dynamic processes** embedded in supporting career development of environmental / sustainable development professionals.

Inkson (2007) noted that stories could provide commentary on external institutions affecting careers but that little empirical work has been done within career research around this dimension. This is an area to which this study can contribute through its analysis of generative mechanisms shaping pathway formation. As argued above, while providing useful insights into learning pathways and their construction, a focus on career stories only is inadequate for developing a deeper understanding of the *relationship* that exists between individual learning pathway biographies, and wider structural and systems views within a wider, critically emancipatory and transformative view of learning pathways research.

In pondering the boundaryless career, which is relevant to the characterisation of environmental occupations in this study (see Chapters 3 and 6), Weick (1996) maintained that careers consist of “work experiences that rise prospectively into fragments and fall retrospectively into patterns – a mixture of continuity and discontinuity” (p. 40). When we craft a story about our career, we impose patterns with the benefit of hindsight. Inkson (2007) elaborated: “we know what we want in the present and that guides us retrospectively in our search for a plausible story” (p. 233). The critical realist underlabouring in the study helped to counteract some of the limitations of the retrospective data that emerged in the storytelling process.

Field (2012) highlighted that use of stories can provide ‘meaning and authenticity’ from people’s experiences of a rapidly changing world. It is important to articulate the stories of people who may be marginalised in traditional forms of research, yet whose stories may enable us to develop a more nuanced understanding of learning and educational processes. The following similarities can be noted between life history and life course (see Chapter 3): both are forms of interpretative research, both use interviewing as their primary mode of data collection, both focus on the stories people tell about (aspects of) their lives, both have to deal with questions about the interpretation of stories and issues of context, structure and agency and the ethical issues involved in exploring

people's lives, and both aim to understand the temporality of learning (i.e. learning takes time and changes over time).

5.3.1 Using Curriculum Vitae (CVs) to deepen understanding of how people navigate between study and work

To enable me to identify consistencies and inconsistencies within and between career accounts, I used curriculum vitae alongside the in-depth interviews to construct the career stories. The CV is a rich source of longitudinal data, which lends itself especially well to the study of phenomena associated with careers and labour flows (Dietz, Chompalov, Bozeman, O'Neil Lane, & Park, 2000). The CV is useful as a data source as it often recounts the entire career of the professional; it is often not simply a list of credentials, but a historical document that evolves over time capturing changes in interests, jobs, and collaborations, job moves and learning moves (Dietz et al., 2000). CVs are thus another chronological narrative form that represents the sequence and chronicle of career development. Despite the familiarity of the CV, there is little knowledge of its social meaning, its use as a research tool and its various practical problems (Dietz et al., 2000). It is important to consider some of the limitations of using the CV as a data source. Dietz et al. (2000) highlighted that information in CVs is self-reported and Sandstrom (2009) cautioned that it represents condensed 'truncated' versions of the story. I nevertheless found it to be a useful complementary data source.

5.4 The research process

5.4.1 Selection of cases

I decided to use occupations as the basis of two of the occupational cases as explained in Chapter 1. The ESSP research had identified several scarce skill occupations and I decided to use this scarce skill list as a basis for my selection. Ultimately I chose the environmental engineer because I knew that it was a fairly new emergent occupation, and both the environmental sector as well as the engineering sector had very little information about this occupation. The environmental scientist was also selected as it was an occupation consistently appearing on South Africa's scarce skill list, and its choice was further informed by discussion with the research manager from the CATHSSETA (where the conservation chamber is housed). His concern was that employers were continuously listing 'environmental scientist' as a scarce skill but the SETA was not able to understand the supply problem. Thus the study was designed with two occupations as two cases. I felt the study also needed a perspective on the national supply platforms as so much of pathway provisioning is

contingent on this. So I developed a third 'entity' which was not a case in the sense of the previous two occupations but which would provide the study with a good empirical context of the transitioning post-school system and would ground the open system framework of critical realism. I also believed that this 'case' could contribute to the emancipatory intent of the study. Selection of cases was thus purposeful as well as strategic.

5.4.2 Negotiating access

The first critical aspect for researching the two scarce skills cases, within the occupational cases, was securing access to professionals that would be willing to share their career stories. I set up general criteria for selection of respondents to guide access and participation for both cases:

- Racial distribution;
- Gender distribution;
- Types of workplaces – different companies, contexts of practice, specialisations; and
- Age distribution.

I sought to identify a sample of approximately ten professionals per case to review. I started by using my professional networks. I sent an email to people I knew working in companies that would be likely to employ environmental scientists and environmental engineers, explaining my request and asked them for an email introduction to any colleagues that might be willing to participate as research subjects. This worked very well and I secured a number of referrals fairly quickly. I emailed referred contacts and requested 60 minute interviews.

Environmental scientists: Securing time of consultants was a challenge so I opted to proceed with the first acceptances I received. I then tried to contact people from different industries and different specialisations, e.g. I contacted contacts at financial institutions to see if I could meet with a person working with sustainability in the business world. I eventually managed to secure interviews with ten scientists that aligned with the criteria above, after emailing and attempting to set up interviews with about 30. The interviewed professionals worked in fairly diverse workplaces – energy parastatal, biodiversity parastatal, conservation parastatal, a financial institution, and some environmental consultancies. Details of interviewees are provided in Chapter 7. I sent emails to the ten people that agreed and outlined the aspects that I would be interested in, requesting people to send me CVs in advance so that I could go through them before the interview. Eight of the ten scientists sent their CVs to me.

Environmental engineers: I tried to meet with respondents from diverse companies but this was a little difficult. Locating environmental engineers was difficult as job titles did not correspond and initially I was referred to anyone that had done some environmentally related work. Again I relied on social and professional networks and tried to secure details of environmental engineers within their companies. I also search through LinkedIn for environmental engineers practising in South Africa. Simultaneously I contacted environmental engineering professors at two universities and set up interviews with them. I then asked them to refer me to some of their masters graduates. This proved to be the most successful strategy and I managed to meet with three that had actually chosen to do a postgraduate degree in environmental engineering. Again I tried to secure a range of different ages, genders and races: I succeeded in finding different ages, managed eventually to secure two Indian females but was unable to find Black engineering graduates that had specialised in environmental engineering. The two professors corroborated that over the years they could not remember a black environmental engineering graduate. The profiles of the interviewees can be found in Chapter 6. Again I sent emails to people that had agreed to participate in interviews, outlining the interview process and requested CVs; only one engineer did not share his CV. I was eventually able to interview 11 environmental engineers.

Participation in Skills Development Networks: In trying to understand the broader skills development processes as well as the emerging environmental focus within skills development, I actively participated in different forums (e.g. National Environmental Skills Planning Forum, Environmental Skills Summit; Human Resources Network; Waste HCD Focus Groups) and skills processes (Sector Skills Planning Working Group Meetings; QCTO public consultations; Occupational Qualifications Development in two SETAs). These processes have supported the development of Case 1 as explained and outlined within Chapter 5 but also deepened insights into the two occupational chapters. I have also discussed my participation in these processes throughout this chapter. This participation enabled me to make contacts, establish relationships and develop a deeply contextual understanding of these processes. During these processes I taped discussions as voice memos were relevant and following participation in these processes, I developed field notes of issues relevant to my study.

5.4.3 Organisation of this study

The study design utilised a more complex notion of learning pathways as neither completely individualistic nor wholly structurally determined (as outlined in Chapters 1 and 3). The concept of learning pathways used in this study was informed by the critical/social realist recognition that

structures precede human actions *and* that agents may influence structures and exercise reflexivity as they ‘make their way through the world’ (Archer, 2000; Bhaskar, 1998a). Based on this emergent view of human development central to critical realism, the perspective on learning pathways as discussed in Chapter 3 recognises that systemic and structural factors shape learning pathways in certain ways, but agents (the individual learner; or other corporate agents) can shape the learning pathways in certain ways too. The critical realist lens of laminated systems enabled me to work with learning pathways a multi-layered concept (see section 3.4.2). It was my deliberate intention to place the stories alongside the systems analysis to help me develop a more nuanced view of the real learning pathway within a laminated system framework.

This design provided a relatively substantive approach for learning pathways research, in which the individual learners’ learning pathway experiences and absences were not neglected or reified within either a focus on career stories, or wider (open) systems based analysis of learning pathways. Figures 5.1, 5.2 and 5.3 all provide deeper insight into how the study was organised within the critical realist laminated system framework.

In the next section, I outlined the overall methods of data generation and the type of methods used within the study to gather data.

5.5 Research methods

5.5.1 Overview of data generation

This study could not draw on any related previous South African research so I had to develop a conceptual understanding of the meaning of learning pathways within the South African NQF by trying to participate in various educational processes and consultations. Working with new emerging occupations and no previous research, within a transitioning education and training system, was challenging; hence the considerable effort in participating in the field of practice, which was crucial to my overall conceptualising of the research. While I have specified the various sources of primary data, as research is a social process, I also acknowledge that my understandings, interpretations and discussion drew on my broad involvement in both general educational processes as well as participation in various processes related to environmental skills development (see section 1.3.2).

The research was designed in a multi-layered manner which, though presented here in a linear way, was much more iterative, interconnected and overlapping in practice. Alvesson and Skoldberg (2000) reminded us that data and facts are the constructions or results of

interpretation. Interviews and document analysis formed the initial methodological backbone of this study. However, to fully understand the research context and the laminated totality of it, I immersed myself in various processes in the field. The field notes I generated from these were a significant part of the study data.

Acknowledging Scott's (2010, p. 11) position that the researcher, by definition, "engages with the world and provides a description of it", helps us to recognise that philosophical issues are implicit in methodological decisions that are made in the way data is collected and analysed.

Connecting macro and micro data: Making links between micro and macro level data has always been problematic (Felin & Foss, 2006). This has been identified in Chapter 3 as a key issue confounding learning pathways research. In this study I have looked at macro and micro as separate only as analytic categories while fully acknowledging that they represent different layers of empirical reality and through the study I could explore the relations between these layers as enabled by the laminated system framework, depth ontology, emergent properties, all of which I have situated within the framing of societal transitions. But Felin and Foss (2006) highlighted the "need to *explain* the individual level *origins* or micro-foundations of collective structures as they arise from individual action and interaction" (p. 2). This is not unlike critical realism's insistence on the relationship that exists between the singular concrete and the universal concrete. The multi-level perspective on sustainability transitions as well the critical realist laminated systems concept used in the study allowed the study to connect macro and micro data.

5.5.1.1. Semi-structured interviews

Doing interviews well requires preparation and a clear mind. In the interviews I realised that the researcher is a critical data gathering instrument, and is required to think on his/her feet, inviting participants to explore the limitations of their responses and provide contexts where needed (Somekh & Lewin, 2011). Open-ended interviews build conversationally, mapping the themes as they unfold, with researchers entering and learning how to behave in the worlds of others (ibid.). I conducted different types of interviews in this study, which are detailed below.

Career stories: My main interviews in this study were the 19 interviews with practitioners around their career stories. When setting up the interviews I explained that the interview would cover various aspects of a career pathway from schooling to the present job (see Appendix A). The interviews covered schooling, subject selection, undergraduate studies, entry into the workplace, postgraduate studies, professional development courses, occupational progression and general

transition into an environmental job. Thus, these interviews were comprised largely of retrospective data, “although we know theoretically that there is always more and other than what is spoken, it is crucial to remain cognizant of the fact that we are also working from the actualities of people lives as the people themselves know them” (Fusco, 2008). I prepared an interview schedule, which was meant as a guide, but each interview unfolded differently as people tell their stories differently (see Appendix A). I thus largely allowed people to tell their stories and only if they missed important aspects would I probe to deepen their responses. For example, some would start immediately telling me about their current jobs or they would talk about schooling but miss things like subjects taken. Each person’s story took a completely different format. Although I had requested an hour, some took as long as two and a half hours.

Table 5.1 below illustrates the other interviews in the study besides the career stories. Interviews comprised of:

- **Strategic key informant interviews:** These were very structured and I developed a questionnaire that enabled me to ask specific questions related to each case and the strategic reason I was interviewing that person. Some of the key strategic interviews involved faculty members at universities and key members of environmental skills forum for systemic insights into data gathered e.g. after the NLRD qualifications analysis, I set up three interview at the South African Qualifications Authority, where I questioned interviewees on how the database data was gathered, catergorised and checked. This also afforded me the opportunity to share my emerging insights from data gathered.
- **Informal conversational interviews:** These were used to gather perspectives from various colleagues in the education and environment sector. The data gathered was different for each person interviewed.

Table 5.1: Overview of interviews (besides the 19 Career Stories)

ENVIRONMENTAL ENGINEERING	
Institution 1	In 01
Institution 2	In 02
Institution 1	In 03
Institution 3	In 04
STRATEGIC INTERVIEWS	
Engineering	In 05
Engineering	In 06
STRATEGIC INTERVIEWS SKILLS SYSTEM	
SAQA - NLRD	In 07
Qualification Design	In 08
Post School Specialist	In 09
ENVIRONMENTAL SCIENCE	
Skills Authority	In 10
Employer 1	In 11
Employer 2	In 12
Employer 3	In 18
Institution 4	In 13
Institution 5	In 14
Institution 6	In 15
Institution 7	In 16
GENERAL SKILLS	
Strategic Interviews	In 17

Transcriptions: I deliberated around the idea of transcriptions as I was wary of the critique that transcriptions “de-temporalise and de-contextualise oral discourse” (Fusco, 2008). When we transcribe we change form, from oral to written discourse, and many would argue that we miss the many other things people communicate when they speak. So researchers need to be aware of this and engage with transcriptions very carefully. I listened to the recordings many times, took notes and ultimately decided to transcribe career stories. So I developed full transcriptions of the career stories interviews and the strategic interviews, but as I used them I was always aware that the transcription is only a partial record of the person behind the text. The other interviews and conversations were not transcribed verbatim but key issues relevant to the three cases were noted from the voice recordings.

The ethical framework of the study required confidentiality and the interviews remained anonymous. I had decided that although people had willingly agreed to share their career stories, their various employers and other lives linked to theirs had not, so it would be unethical to use their names. I discussed this with each interviewee and assured them of confidentiality.

5.5.1.2 Document Analysis

Documents play a significant role in qualitative enquiry. They can be beneficial not only in terms of what can be learnt directly from them but also as a stimulus for paths of enquiry – they are ‘leads’ as described by Patton (2002) that can be pursued through either observation or interviews.

Analysis of documents was critical to this study. There was a wide range of documents – education and environmental policy, government strategies and frameworks, workplace skills plans, sector skills plans and relevant documents linked to the two occupational cases. Significantly I reviewed a number of ‘system document’ or artefacts. When using documents, I was aware of the context of each document. The following are examples of types of documents reviewed:

- Professional Body Documents
- NQF Documents and Gazettes e.g. Green Paper to Post School Education; White Paper to Post School Education; Amendments’ to NQF Act
- Policy Documents – skill system documents; green skill documents; environmental policy documents
- Career Development resources
- Recent research reports related to green economy
- Recent research reports related to skills development e.g. SIPS
- Sector Skills Plans
- Workplace Skills Plans.

5.5.1.3 Observations

Somekh and Lewin (2011) emphasised that observation is a very important part of data collection: “It entails being present in a situation and making a record of one’s impression of what takes place” (p. 131). I used observations in this study to enable me to gain a deeper insight into issues related to selected occupations and the sector more broadly. Patton (2002) highlighted that good quality observation is about developing the skills to move from ordinary looking, to the rigour of

systematic seeing. I used observations in various ways, related to how I participated in the sessions/meetings/workshops which ranged from being an onlooker as well as a participant, and sometimes both (Patton, 2002). I did not prepare observation schedules as I was never sure what would transpire; thus my observations were largely unstructured and some could be described as 'participant observation' (Somekh & Lewin, 2011).

I declared openly at all meetings that I was a PhD student undertaking this research and that observation and participation in system related events and processes was part of my research as I was researching a complex emergent phenomenon. If I needed to tape discussions to supplement my observations, I requested permission (e.g. in the environmental managers occupational working group of the DHET). It was impossible to get permission in plenary sessions and government meetings, so I made written observations of discussions and debates as these were public meetings. After meetings I developed field notes linked to areas that were most useful to me. In meetings where I had not previously arranged informed consent, I did not directly quote anyone, as I believed this would be unethical without formal permission. I thus used the meeting field notes and ascribed any idea I needed to use to the meeting rather than any individual speaker. I was however careful not to report any data or events that were explicitly indicated as confidential.

The scope of observations included:

- Human Resource Development Network (HRD Network) – this was an informal body of HRD managers from key environmental organisations. They met three times a year to discuss issues related to workplace skills planning. In certain meetings (HRD network I was sometimes a co-facilitator and sometimes a participant. I attended 10 days of workshop in total.
- Engineering sector meeting – I was an uninvolved onlooker.
- Strategic Infrastructure Programmes (SIPs) – This is a government led strategic programme looking at large-scale infrastructure development. In SIPs meetings I was an onlooker in some sessions (plenary) and a participant in others (in occupational working groups for environmental engineering and environmental management I was an invited member of the working team in these two groups – I was invited largely because of my research but in both teams I declared that I was a PhD student and indicated my study interest and that I was also making field notes for the study). I attended about eight days of contact

engagement with the team as well as engaged in a wide range of collaborative activities online.

- Government meetings related to skills planning – I was onlooker e.g. attended meetings of the QCTO; public consultations of the Green Paper for the Post School system.
- SAQA research seminars – over the course of the project I attended six research seminars.

My observations spanned over two to three years in some instances e.g. I observed and participated in HRD network meetings over ten days in a two-year period. Over the three years of this study, I had filled about five notebooks of observations from meetings that I had attended. The days of sitting in these meetings were critical in helping me to develop a coherent cumulative picture of the essentially emergent and changing education and training system I was studying.

5.5.1.4 Field notes

As indicated above, I spent a considerable amount of time in this study participating in meetings, workshops and consultation processes. Field notes thus became a very useful tool to provide relatively objective record of my work in the field. Field notes are “gnomic, shorthand reconstructions of events, observations, and conversations that took place in the field” (Wolfinger, 2002, p. 85). Due to their very private status, field notes remain an under-acknowledged part of social science research (Bloor & Wood, 2006). Field notes enable the researchers to capture detail and multi-layered richly contextualised descriptions, thus enabling thick description and the capturing of the ‘insider understanding’ experienced during fieldwork (Bloor & Wood, 2006).

Bryman and Bell (2003) identified three classifications of field notes based on suggestions by Lofland and Lofland (1995) and Sanjek (1990). These are: mental notes when it may be inappropriate to take notes; jotted or scratch notes, taken at the time of observation (non-participant observation; participant observation) or discussion and consisting of highlights that can be remembered for later development; and full field notes written up as promptly and as fully as possible. Across the period of my study, I utilised all three types of field notes, captured in the five note-books referred to above.

While I fully accept that qualitative research is experienced subjectively, it is important to acknowledge the role of the researcher’s tacit knowledge and beliefs in the creation of field notes. Wolfinger (2002) emphasised that tacit knowledge is probably the most important consideration in determining what is worthy to annotate. This related to the point above about ‘systematic seeing’ which, in the context of my study, crossed micro-macro divides as noted above, involving

systemic issues, individual experiences, dynamic changes occurring and emerging. Table 5.2 below provides an indication of the field notes developed in the study.

Table 5.2: Overview of field notes

Activity	Field Note Reference
CathSETA OFO Workshop	FN 10
HRD Network 1	FN 11
Network OFO 2	FN 12
Network Training Shortages 3	FN 13
Network Skills Planning 4	FN 15
SIP's Env Manager Occupational task team (OTT)	FN 14
SIP's Env Engineering Ott	FN 9
CESA Meeting	FN 8
ETDP SETA	FN 7
LG SETA	FN 6
QCTO Meetings	FN 5
EE OFO Consultation	FN 4
PACE Career Consultation	FN3

5.5.1.5 Voice memos

I used voice memos extensively in my study. This entailed taping research interactions on my Apple cell phone and then backing these up as audio files. I opted for this rather than a tape recorder as it is automatically synced with my laptop and would backup in iTunes and the iCloud. I taped discussion sessions with environmental colleagues, discussions with government officials, discussions with my supervisor, with other professors at my institution and with colleagues from my PhD group with their permission. These were not transcribed but I listened to them numerous times, noting key points and issues and introduced them into the data as voice memos.

Table 5.3: Overview of data generated

Description	Focus	Data Generation Processes
Overview of environmental policy and emergence of green economy in South Africa	Environmental Policy	Field notes
		Document analysis
	Educational Policy	Voice memos
	Green Economy	Observation
Green Skills Provisioning to support Environmental Learning Pathways	Qualifications Analysis	Sourcing and reviewing database Analysis of NLRD qualifications database Identify and review of 23 institutional websites
	Occupational Analysis	Sourcing and review of OFO database which OFO analysis over three years
	Career Education	Sourcing and review of six key career resources Sourcing and review of career research on environmental careers Interviews with 2 career programmes
	Workplace Skills Planning	Participation in 8 days HRD Network workshop observation Site visit – HRD manager – conservation workplace Review of Sector Skills Plans – three SETAs – CATHSETA; Energy and Water; Local Government
Occupation 1: Environmental Engineering	Context of engineering in South Africa	Sourced and reviewed various documents related to engineering in South Africa Interviewed Engineering Education Interviewed key member of Engineering Council
	Development of Career Stories	Interviewed 9 environmental engineers for general issues related to environmental engineering
	Environmental Engineering	Interviewed 3 professors of engineering leading environmental engineering masters programmes Participation in DHET occupational group for environmental engineers
Occupation 2:	Context of Environmental	Review of documents

Description	Focus	Data Generation Processes
Environmental Scientist	Sciences in South Africa	Interviewed 2 university professors
	Development of Career Stories	Interviewed 9 environmental scientists Sourced CVs
	Development of Environmental Sciences	Interviewed 2 employers SATNASP member Site visit – environmental workplace to interview scientific manager and HRD manager Participation in DHET group on environmental managers

5.6 Ensuring data quality and validity

5.6.1 Research validity

In any research validity, reliability and ethics are major considerations (Merriam, 2009). Cohen, Manion and Morrison (2004) noted that in “qualitative research, validity might be achieved through the honesty, depth, richness and scope of the data achieved, the participants approached, the extent of triangulation and the ... objectivity of the researcher” (p. 105).

Validity is a multifaceted concept but within this study, I endeavoured to ensure that the three types of validity that are relevant to qualitative research (descriptive, interpretive and theoretical), were carefully considered throughout the research process. To ensure descriptive validity, I maintained the ‘factual accuracy’ of the account (Maxwell, 1992) by ensuring that the research faithfully represented what “actually happened (objectively factual)” (Cohen, Manion, & Morrison, 2004), while recognising the possibilities of critical realist retroductive analysis which does not seek positivist correspondence with reality. To maintain interpretative validity within the study, I strived to ensure that “meaning, interpretations, terms, intentions” (Cohen et al., 2004) always represented the “participant’s perspectives” (Maxwell, 1992) and that interpretative accounts were grounded in the “language of the people studied ... their own words and concepts” (Maxwell, 1992) without succumbing to methodological individualism which Bhaskar highlighted is a belief that facts about societies and social phenomena are generally explained solely in terms of facts about individuals (Bhaskar, 1998a, p. 208) . Maintaining theoretical validity involves ensuring validity of the concepts as they are applied to the research phenomena and the validity of the hypothesised relationships between the concepts (Maxwell, 1992; Cohen et al., 2004). Theoretical validity in this study also involved maintaining a commitment to open systems as revealed by

critical realist researchers. The quality of retroductive inference also had to be conceptualised and justified; little methodological guidance exists on how to ensure validity in retroductive mode of inference. Price (2007) showed that testing findings against other instances of similar research can assist with validity of retroductive inferences.

Reflecting on my position as a researcher within the study enabled a degree of self-awareness of my biases, dispositions, world and assumptions. This constant critical self-reflection enables a much more credible research process and product. Lather (1986) described this as researcher reflexivity and argued for careful reflexivity on the part of the researcher, which involves taking account of positionality in the research as well as one's own influence. Bourdieu (2004) commented that reflexivity in research should reach beyond the reflexivity of the individual researcher, and should be field-based; in other words, the relevance of the research needs to be 'tested' in the field and appropriately located within the field. To do this involved exposing the unfolding research and findings to various audiences such as SAQA, the environmental education community, the South African Environmental Skills Summit etc. and undertaking careful literature reviews (Chapter 2).

To a large extent, validity and reliability in a study is dependent on the ethics of the researcher. Thus it was critical that within the study I remained "conscious of the ethical issues that pervade the research process" (Merriam, 2009, p. 235). To steer the study's ethical considerations, I was guided by the three broad areas recommended by Bassey (1999, p. 73): "respect for democracy, respect for truth and respect for persons". I paid special attention to negotiation of access by requesting permission and consent well in advance, observing all necessary protocol. All research participants were assured of anonymity and that no personal information would be divulged.

5.6.2 Critical friends

Throughout this research I drew on my critical friends in various ways at different stages. Two critical friends supported the whole research process – I had one critical friend in the South African Qualifications Authority and a second in a skills authority, and both helped me to deliberate and understand various issues related to skills development. The PhD weeks at Rhodes University provided excellent opportunities for sharing my research and receiving feedback from the broader community of educational researchers. I presented my research during PhD weeks at various stages of the project. I also had a mentor in GreenMatter as I was part of a GreenMatter fellowship. As an ex-professor from my university, this mentor was particularly helpful and provided considerable input, both into my study as well as in my general academic development.

5.6.3 Immersion in the field to develop deeper contextual understanding

As described in the section on observation and because of the rapidly changing landscape surrounding this research and the dearth of previous research in this area in South Africa, I needed to develop a broad contextual understanding of the study terrain. So I spent a considerable amount of time participating in activities like meetings, public consultations that helped me develop a deeper understanding of the context. I attended various government public meetings which helped me to develop a contextual understanding of the post-school system. I participated in the National Environmental Skills Planning forum to explore critical issues in the environmental sector. I participated in the Tertiary Access focus group, in two career development programmes in the environmental sector, in HCD programmes in related environmental sectors (waste sector HCD programme), a public meeting related to qualifications development in Sector Education Training Authority (SETAs) (Local Government; Education and Training) and in skills planning focus group meetings in SETAs e.g. Services, CATHSETA, ETDPSSETA, Finance SETAs.

5.6.4 Field based resonance

Throughout my study I endeavoured to feed the work I was doing back into the sector as ‘work in progress’. I analysed data on occupational frameworks, which I shared very widely with colleagues as well as HRD colleagues in the HRD network. Similarly, when I did an analysis of qualifications, I shared the data very broadly. I used my emerging insights in several processes e.g. in the Careers Project Management Team for Biodiversity and the CATHSETA research programme at Rhodes.

I developed a short concept paper around issues emerging from my study – which was shared at the Department of Higher Education and Training related to insights around environmental engineers and environmental scientists. All these helped to establish the field based resonance of the study and through responses to the work I was able to strengthen my work while making a substantial sector contribution.

I presented my study at the 2012 Environmental Skills summit and shared some emerging insights. I also presented aspects of the study at various meetings within SAQA as well as in a presentation at the Researching Work and Learning Conference in Stirling in the United Kingdom in 2013.

5.7 Data analysis

Working from the idea that reality is not always as it appears on the surface, critical realism forces us to deepen our logic of complexity, so we are able to investigate beyond the surface into history

and context to develop a deeper understanding of reality. Cautious of the epistemic fallacy researchers need to ensure that they avoid conflating what is experienced as what is, with what can be known – our knowledge and experience of something is not what is real. The critical realist lens enabled the study to shift its focus from events that can be empirically observed to develop a clearer picture of the mechanisms that have produced the events and experiences (at Bhaskar's 1M – see section 3.4). Critical realism helps us to understand these mechanisms are not less real simply because they are not directly observable. This enabled the study to “forge contact with the reality that exists beneath the level of events” (Blom & Moren, 2011). In the career stories, the critical realist underlabouring enabled the study to deal with the critiques of life course heuristics and its consistent focus on abstracted events. Across the study it was necessary to collect data that gave me information about the reasoning of different stakeholders.

5.7.1 Modes of inference

Inferences are thought operations that enable a researcher to form an argument (Danermark et al., 2002, p. 77). While Danermark et al. (2002, p. 79) emphasised that the different modes of inference used in research are complementary, it is essential that we understand clearly what they involve and how they support the research process. Using Pierce, Danermark et al. (2002) further outlined that a mode of inference is “ways of reasoning, thinking and arguing” (p. 89). The discussion below highlights some of the main types of inference used in this study.

5.7.1.1 Induction

Induction involves drawing conclusions about all from knowledge about a few without leaving the empirical level (Danermark et al., 2002, p. 77). Thus, from a limited number of events or phenomena, a researcher draws conclusions applicable to the larger population. So using induction as a mode of inference, the researcher starts in the concrete and endeavours to abstract and isolate the basic constituent (ibid., p. 78). Danermark et al. (2002, p. 87) pointed out that “induction gives no guidance as to how from something observable we can reach knowledge of underlying structures and mechanisms, it is limited to conclusions of empirical generalisations and regularities”.

In this study I used induction to make sense of the pathways of environmental professionals – after carefully reading the interview data many times, and then the CVs, I used induction to code and organise the raw data from the career stories onto analytical spreadsheets. This allowed me to look at the career stories and meaning around the mobility, the agency and the key life events.

The inductive work helped me to organise the stories according to common life events and generate key themes emerging across the data (see Chapters 6 and 7).

5.7.1.2 Abduction

The concept of abduction was developed by American philosopher, Pierce – central to Pierce’s ideas were that “abduction is a fundamental aspect of all perception, of all observation of reality ... social scientists using Pierce have further emphasised that abduction involved re-description and re-contextualisation” (Danermark et al., 2002, p. 89; Bertilsson, 2003). Further elaboration by Danermark et al. (2002, p. 93) helps to develop a clearer understanding of abduction: “abduction is a form of creative reasoning that enables a researcher to:

- discern relations not obvious;
- to formulate new ideas about the interconnections; and
- to think about something in a different context and an ability to see something as something else.

Abductive logic does not result in absolute truth, but through the process of re-description it does provide a better and deeper knowledge of the case being studied. In a critical realist study, knowledge is always treated as fallible. This is how I essentially used abduction in the study: I used different theoretical frames to help me to make meaning of my data and develop a “more developed or deeper conception of it” (Danermark et al., 2002, p. 91). In my research I used theoretical ideas around learning pathways (Chapter 3), transitioning to sustainability (Chapter 2); learning and work (Chapter 3).

5.7.1.3 Retrodution

Generative mechanisms are an important part of critical realist research. They explain how and why events happened and thus enable greater depth in the understanding of social phenomena. In research there is a need to surface and acknowledge these mechanisms, as they are not less real because they are not directly observable. Retrodution helps to analyse the basic transfactual conditions that have created the “social meanings, structures, and mechanisms” (Danermark et al., 2002, p. 92).

Retroductive analysis is a form of inference that uses transfactual arguments to develop an explanatory understanding of underlying mechanisms. The questions below, drawn from Danermark et al. (2002, p. 100), help to frame transfactual arguments:

- What properties must exist for X to be what X is?

- What causal mechanisms are related to X?

Research needs to acknowledge these mechanisms are not less real because they are not directly observable but they exist in the domain of the real – whether we are able to conceptualise them or not. Thus retroductive argument allows us to reason the existence of something unobservable by seeing the effects of it.

5.7.2 Data analysis within this study

The table below represents broadly the way I analysed data in this study. The career stories were subjected to multiple layers of analysis, using different conceptual tools to surface the nature of the learning and work transitioning and the factors influencing the transitions.

The system structures were a little different and I used ideas of representation to understand the responsiveness and how this new area (green skills) was manifesting within supply structures. I outline two below as these are central to supporting learning pathway formation.

Qualifications system – I studied the South African National Learner Record database. This is the database of qualifications registered within South Africa. The database currently contains 15 000+ qualifications registered in South Africa. It was impossible to filter out environmental qualifications as they are cross-cutting and embedded in various sub-fields. I therefore had to review every qualification data record listed to determine its appropriateness and relevance to the environmental sector. From this analysis I compiled a list of environmental qualifications, which I could then subject to further analysis according to the NQF levels and the sub-fields of these qualifications. I had to undertake this process twice, I completed the first analysis in December 2012 and in June 2013 SAQA changed the database to reflect 10 levels. My original data reflected the eight level NQF framework of qualifications. I therefore redid the analysis so it was an accurate reflection of the NLRD database (see Chapter 5). Although it was a huge task to go through the very extensive database twice, it did give me a clearer picture of how the qualifications database was responding to the emergence of environmental demands in a qualification or not.

Organising Framework for Occupations (OFOs) – over the course of the study I studied the OFOs three times by analysing the South African occupational database. It was impossible to filter environmental occupations so it was necessary to go through the database line by line and select the environmental occupations. I worked with two years of analysis: early 2010 and 2013. This enabled me to reflect on the change as well and get a better picture of how the occupational

landscape was changing. I then tried to examine the emergence of environmental occupations and how green OFOs were being interpreted.

Table 5.4: Overview of data analysis processes

CASE 1
<i>Types of qualifications</i> <i>Defining of occupations</i> <i>Career development systems</i> <i>Sector skills planning</i> • <i>Representation</i> • <i>Responsiveness</i> • <i>Newness</i> Surfacing the critical patterns of Emergence of Green Skills within the Post-School Sector
ANALYSIS OF OCCUPATIONAL CASES (CASE 2 AND CASE 3)
Environmental Engineer and Environmental Scientist <i>19 career stories</i>
LAYER 1: Sequence of key life events: understanding transitions using a pathways frame <i>“How transitions combine ‘turning points or milestones or life events’ with subtle complex processes of ‘becoming somebody’, personally, educationally and occupationally”... the evolution of a professional or occupational identity in a field, navigating uncertain labour and educational systems</i> <i>‘Trigger events’ ...</i> Drawing on life course work – Understanding how individuals navigated pathways from schooling to university
LAYER 2: Systems of influence (Patton & McMahon, 2006) <i>Individual, family, historical, media, political decisions, peers, geographical, educational institutions, class, employment work; socio-economic status; globalisation</i>
LAYER 3: Understanding career mobility <i>Mobility patterns - multidirectional (>>>); work role transitions; job crafting</i> <i>Ease of movement</i>
LAYER 4: The story of the crafting – the agent in action? Work role transitions <i>Assemblages of practice</i>

LAYER 5: Selected occupational and system insights on the institutional and structural factors that support these occupations • <i>Review of qualifications available</i> • <i>Occupational – framing within OFO</i> • <i>Role of professional body</i> • <i>Workplace skills planning insights</i> Review of Green Skill: • <i>Representation</i> • <i>Responsiveness</i> • <i>Newness</i>
Factors influencing learning pathways Systemic and agentic factors shaping the learning pathway Underlying generative mechanisms which enable and constrain learning pathway development Patterns of emergence
TRANSFORMATIVE PRAXIS ANALYSIS
DIALECTICAL CRITICAL REALIST ANALYSIS (MELD) ACROSS CASES 1,2,3: -Being (<i>what's real, actual? – depth ontology</i>) -Absence (<i>what's not there? – causal power of absence</i>) -Totality (<i>what could be there? – reimagining totality</i>) -Transformative Praxis (<i>what are the possibilities? – how could it come into being?</i>) RAISE ABSENCES AND OPPORTUNITIES/ POSSIBILITIES FOR TRANSFORMATIVE PRAXIS FOR ENVIRONMENTAL LEARNING PATHWAYS

5.8 Reflexive research

The study of social phenomena (which operates in open systems) involves a double hermeneutic (Sayer, 2010). The Sage Encyclopaedia of Case Study Research (Mills, Durepos, & Wieber, 2010) described a double hermeneutic as:

concomitant production of meaning and meaning-making within the research process ... the context of that which is being researched (often referred to as the object of the research) and the context of the researcher (often referred to as the subject of the research) – interact dialogically and co-inform one another within the research process. (p. 323)

This emphasises the complexities of meaning-making in social science research. Sayer (2010) further explained that the existence of the double hermeneutic requires a conscious or examined interpretation of concepts and beliefs in society. This necessitates rigour and self-awareness in how researchers engage with their interpretive and meaning-making throughout the research.

Alvesson and Skoldberg (2000, p. 5) highlighted different uses of reflection in research but essentially reflection helps a researcher to draw attention to the “complex relationship between processes of knowledge production and the various contexts of such processes as well as the involvement of the knowledge producer”. Reflexive research means that “serious attention is paid to the way different kinds of linguistic, social, political and theoretical elements are woven together in the process of knowledge development” (ibid.).

Reflexive research has two basic characteristics: careful interpretation and reflection (Alvesson & Skoldberg, 2000). To improve reflexivity researchers are advised to acknowledge that all empirical references are results of interpretations and to put interpretation at the forefront of their research work, by being aware of their theoretical assumptions, the importance of the language they use and pre-understanding, all of which underpin interpretation. The second criterion of reflection requires the researcher to turn the lens inwards, “towards the person of the researcher”. Reflexivity engages the interplay between philosophical ideas and empirical work – this enables a researcher to undertake interpretation of interpretation and enables critical self-exploration of one’s own interpretation of empirical material (ibid., p. 6).

5.9 Conclusion

This chapter has attempted to outline the rigorous process of data gathering and data analysis. It has described the methodological process and the research methods used in this study. It thus provides a comprehensive rationale for what I did throughout this study, how I did it and why.

This chapter has provided an overview of cases, how the cases have been constructed in relation to some of the theoretical work of the study. In addition to describing the data analysis process of

this research, it has described how I sought to ensure quality and validity in the study and the chapter ended with a brief exploration into reflexivity and its importance in research. The next chapter introduces the three cases that form the central backbone of the study.

CHAPTER 6: GREEN SKILLS SUPPORT – EVERYWHERE BUT NOWHERE!

Education and training systems are challenged to incorporate new skills demands in the development of qualifications, curricula and trainings in a coherent, well coordinated and integrated manner.

The principal deficiency reported in public systems is weak responsiveness to changing industry needs.

ILO (2011a, p.2)

6.1 Introduction

Chapters 1, 2 and 3 mapped the context of the transitioning educational and environmental system within South African society as well as the historical development of environmental discourse in South Africa. I suggest that despite rapid and expanding commitment to green skills at a political and policy level, many challenges still exist which this chapter attempts to highlight.

The multi-level perspective I introduced in earlier chapters provided a way of simplifying and thinking about this complexity. As outlined in Chapter 2, it provided some key analytical and explanatory tools that enabled me to conceptualise transition as a multi-level concept. In this chapter I use these ideas to critically review niches as conceptual spaces (in this study ‘key supply platforms’) and describe in detail the change that is starting to emerge as we study their evolution to integrate green skills. This enables the possibility of developing a clearer understanding of regime change processes (see Chapters 1 and 2) that are shaping the emergence of green skills within the South African education and training system.

6.2 Situating the chapter

At a structural level, the South African NQF provides for learning pathways. Seamless learning pathways have for a long time been an important priority for educational policy in South Africa (as outlined in Chapter 3). The STEM Career Pathways Project in the USA (2013-2018) defined ‘seamless’ as “when they provide an orderly and logical continuous flow of steps to reach career goals” (Bartholomew County Strategy, n.d.). To date, however there are insufficient concrete insights into what happens within learning pathway formation at a practical level in South Africa and there is no clear understanding of how the environmental learning pathways are constituted (as outlined in section 1.3.1).

This chapter thus provides an overview of the **institutional structures and mechanisms** that support and enable existing and emergent environmental learning pathways. This discussion will also provide the systemic overview and the descriptive background for the next two occupational chapters. I recognise that multiple system factors impact on learning pathways but this chapter explores only a small selection of these system elements.

Drawing on the multi-level perspective (introduced in Chapter 2), it is possible to identify three levels: “the **socio-technical landscape**, which encompasses social values, cultural norms, the natural environment and the macro political economy; a meso-level of socio-technical **regimes**, that include interconnected systems of existing technologies, institutions, rules, norms and practices” (Gibbs & O’Neill, 2014, p. 204) and the third level which comprises niches which are sites for innovations and deviations from the norm. The latter are thus ‘test beds’ for the emergence of practices that confront the lock-in mechanisms of the regime and hence highlight the sustainable regime changes.

In this chapter I discuss important niche level system elements (see Figure 6.1. below), which were selected for their relation to learning pathway provisioning (see sections 4.3 and 4.4.3.1.) and for their relevance to an exploration of the micro-meso dynamics that permeate learning pathway provisioning. For each niche element, I attempt to illustrate how environmental work and pathways are starting to emerge and challenge the regime lock-ins. Thus, each element depicted in Figure 6.1 below is seen as an important niche level systemic factor in its own right, and combined these could potentially offer substantive ‘regime change’ for green transitioning.



Figure 6.1: Different niche level elements relevant to green skills learning pathways construction

This chapter is descriptive and plays an important role in ‘demystifying’ the South African education and training system, which will also be important in terms of contextualising the following two occupational case chapters (Chapters 7 and 8). The chapter also has a critical intent to raise inconsistencies. Drawing from Scott (2010), the chapter thus advances an educational critique that assists in development of deeper knowledge of the object of the study (elements constituting learning pathways) in order to understand possibilities for change. Scott (2010) argued that this facilitates development of a more complete account of reality from which judgements can be made as to appropriate and recommended courses of action. I raise this to emphasise that the description and review outlined in this chapter is not value-free and has a very definite critical intent.

6.3 Exploring demand side insights

Learning pathways are inherently focused on supply side issues; however, a healthy economy is an important factor in creating these learning pathways (OECD, 2000; Raffe, 2008). Since a relatively stable labour market is a recognised criterion for successful learning pathways (Raffe, 2008), the discussion below presents three aspects that illustrate the demand that currently characterises the environmental sector. The section, though short, is intended as an illustrative background for

the supply discussion that emerges in the rest of Chapter 6 and Chapters 7 and 8, and is also essential for interpretations in Chapter 9.

At present, a range of environmental scarce skills have been identified. In section 5.6.3 I discuss the Scarce Skills List in greater detail. Here I aim to illustrate that the scenario of scarcity is continuously flagged as an important demand indicator. This scarce skill scenario can be illustrated using information from DEA (2010a), HSRC (2009) and GreenMatter (2012). The Environmental Sector Skills Plan (ESSP) (South Africa. DEA, 2010a), the first of its kind in South Africa, illustrated scarce skills across the sector and divided them broadly into sub-sectors. Some of the scarce skills highlighted are environmental engineering, environmental sciences, environmental economists, environmental lawyers, environmental management and environmental education and training / human capital development; others are more specialised, e.g. marine climate specialists, long range climate modellers, soil scientists, and water quality monitors amongst others. Table 6.1 below illustrates the priority scarce skills identified in the Biodiversity sub-sector.

Table 6.1: Priority scarce skills identified in the Biodiversity sub-sector

Priority Scarce Skills (Biodiversity sub-sector)		
Agricultural extensionists	GIS specialist and GIS technicians	Taxonomist
Curators	Human capital development specialists	Soil scientist
Ecologist (marine, aquatic, terrestrial)	ICT biodiversity specialist	Social scientist
Environmental engineer	Environmental lawyer	Soil scientist
Environmental manager	Environmental policy analyst	
Conservation and environmental scientist	Resource economist	
Geneticist	Statistical ecologist	

Source: GreenMatter (2012) – an updated refined list of what can be found in HSRC (2009)

Additionally, the green occupations listed as scarce skills within the Sector Education and Training Sector Skills Plans are increasing. This illustrates that skill planning from employers into sectors are showing more recognition for the need for green skills. This is more comprehensively discussed in section 6.6.4.

While GreenMatter (2012) and HSRC (2009) have also usefully clarified the current green skill scenarios, these research processes failed to highlight accurate numbers required. This is

indicative of a more deep-seated problem. Lotz-Sisitka et al. (2013, p. 16) explained that the “general capacity for labour market analysis and accurate prediction of scarce skills is both complex due to high levels of specialisation in parts of the sector, and due to generally poor quality Labour Market Intelligence systems”. Thus it is currently almost impossible to provide accurate numerical values for green skills required. In sections 6.4, 6.5, 6.6 and 6.7 I explore some supply side issues that compound and exacerbate this problem.

Another demand indicator is the green economy predictions for green jobs that are illustrated in Table 2.3. This table provides a more detailed picture of current and potential employment in the main South African green economy sectors by 2025. However, the green economy strategies emerging at present fail to highlight the skills development implications of these projections. They also fail to illustrate other occupational demands that will be necessitated by the green economy re-skilling and up-skilling of staff (see section 6.6).

The above discussion has provided a brief illustrative picture that typifies a sector with a growing, yet generally poorly articulated demand scenario. In the following section I explore this demand discourse a bit more critically in an attempt to illustrate the complex nature of the ‘real’ demand dynamic of green skills in South Africa.

Using national data from a Green Jobs Fund project offering 800 jobs into the conservation sector for unemployed youth, named the *Groen Sebenza* Project [Green Jobs Project]⁴ and involving aggregated data from different environmental partners, I was able to explore the qualifications of youth interested in becoming entrants into this environmental jobs fund programme. I gathered data on **604 Groen Sebenza entrants**; of these 154 applicants had Grade 12 certificates only (i.e. they had no post-school study). This implies that 450 of the entrants into this programme already had a post-school qualification but were unable to secure a job in the sector. The graph below (Figure 6.2) illustrates the distribution of the graduate entrants that had some type of post-school qualification. While the 'seamless' movement of students from one sector to another is a longstanding government policy objective (as discussed in 3.2.2.1), the student experience of articulation shows this has not yet been achieved as reflected below.

⁴ Groen [Green] Sebenza [Jobs] is a Jobs Fund support of 800 unemployed young people in a multi-partner initiative in the conservation sector between government and private organisations.

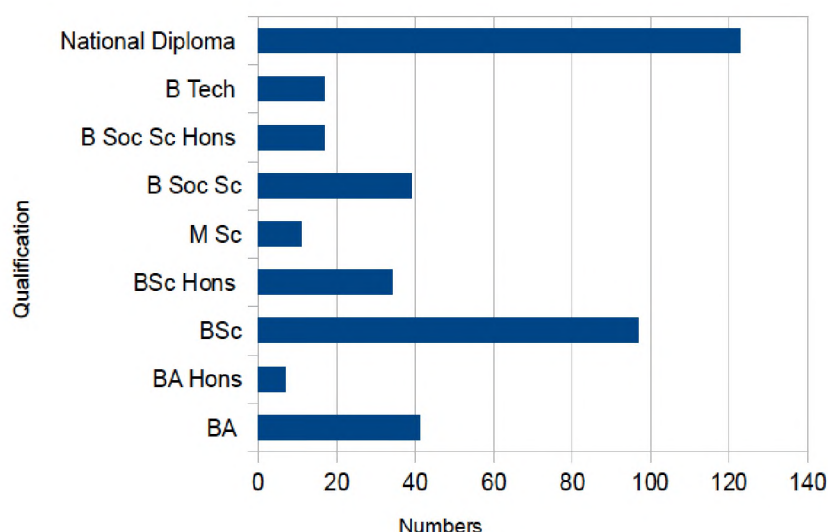


Figure 6.2: Qualifications of Groen Sebenza entrants

This data clearly shows that entry into the environmental sector is not guaranteed by a qualification. This data reflects that there remains a critical problem with students that have secured national diplomas acquiring access into the sector. This is the case with students achieving a generic BSc, this despite the reports that South Africa does not have adequate scientific skills, especially also to service the environmental sector scarce skill needs (South Africa. DEA, 2010a; HSRC 2009; GreenMatter, 2012). Some explanation for this observation is highlighted by what some would argue is a “tendency of the sector to underemploy” (even at entry level jobs employers are looking for masters graduates) (Int 11). This depicts what the European Centre for the Development of Vocational Training CEDEFOP Report (2012) described as technical and normative demands of employers that set up demands of labour supply regarding work content (p. 79). Rosenberg (personal communication, October 4, 2013) has pointed to the need to strengthen students’ awareness and understanding of actual jobs in a workplace:

Even when a student is clear on their intended occupation, they may be unsure of the skills sets and levels required. There is also inconsistency across institutions with respect to the kinds of titles jobs are given and the competencies required to fill these. We need to think more carefully about the jobs that are available in the country, how these are captured in national systems, what the study and career paths are to access them, and we need to communicate these to both first and final year students.

This also alludes to issues with image of the sector amongst job seekers and the types of searching strategies that employees use (Cedefop, 2012). These job entrants’ (and others like them as this is not a nationwide dataset) inability to secure a job in the sector illustrates an **irregular transition point** that needs to be more carefully investigated. The demand dilemma raised by this data from

the Groen Sebenza programme applicants needs much more careful investigation beyond the scope of this study. But it has helped to illustrate that the supply-demand discussion is a complex one and transitioning into work in the environmental sector remains an important factor in understanding learning pathways.

This is corroborated by the Environmental Sector Skills Plan (South Africa. DEA, 2010a) which also found “the **environmental occupations within the economic cluster** have a vacancy rate of 29%” (p. 90). Although demand is not the only criterion to consider in education-labour relations, it is an important indicator of a transitioning system that is working well (or not).

This discussion has provided a **brief illustrative picture** of the demand scenario in the environmental sector in South Africa; it also raises some key challenges, many of which will be further illuminated in the discussion below, which explores the skills development supply platforms. This should help to build a picture of how the education and training system (an important regime in this study) is responding to the emerging demand emanating from the landscape pressures.

Thus the questions critical to this thesis are: What type of learning pathways opportunities exist for the envisaged green jobs? How does the structure of the education and training system respond to these new emerging possibilities? The discussion in the rest of this chapter as well as the next three chapters explores these questions in greater detail.

6.4 Understanding the qualifications currently available

Various authors (Young & Allais, 2011; Allais, Raffe, & Young, 2009) have acknowledged that globalisation and a rapidly changing world are driving the need for people to be lifelong learners and upgrade skills throughout their work life. As introduced in Chapter 3, South Africa has a National Qualifications Framework, which has an explicit transformative intent. This section uses the vantage point of qualifications to discuss how they serve as important niche elements within pathways formation:

- They are the core focus of the NQF (even though the NQF also registers unit standards, they are seen as building blocks for qualifications);
- They are expected to prepare learners for employment and to facilitate entry to career paths; and
- They can be used to govern the provisioning and adequate supply of particular skills in a particular field. In the environmental sector, they were found to be a key leverage point

into employment and hence are a critical element of governing supply of green skills and adequate provisioning. (South Africa. DEA, 2010a)

According to the South African National Qualifications Framework, a qualification can be defined as:

... a planned combination of learning outcomes which has a defined purpose or purposes, and which is intended to provide qualifying learners with applied competence and a basis for further learning; and it means the formal recognition of the achievement of the required number and range of credits and such other requirements at specific levels of the NQF as may be determined by the relevant bodies registered for such purpose by the SAQA [South African Qualifications Framework]. (Nkomo, 2000, p. 4)

Hanf and Hippach-Schneider (2005) described qualifications as “sets of certified or documented skills” and qualification frameworks as having the role, among others, of enabling “flexibility and transferability between different educational and occupational fields” (p. 9). As can be discerned from the above description, there is an expectation that a qualification should equip a learner with suitable skills for particular occupations, among other things.

According to Young and Allais (2011) and Allais, Raffe and Young (2009), qualifications are seen as a ‘proxy’ for what a learner knows and can do, a ‘currency’ which the holders can take beyond the educational institution where they acquired it. They further stated that “a qualification is a token which mediates between educational institutions and between educational institutions and the labour market” (ibid.). The OECD/CEDEFOP, (2014, p. 74) outlined some further uses of qualifications which they described serve to:

- Signal job skills to employers – qualifications that reliably signal relevant skills help employers to identify employees;
- Legally regulate access to certified occupations;
- Qualify as entry routes into occupations and clarify programmes of study necessary to enter occupations (this can play a career orientation role); and
- Provide a means for employers and organised labour to influence the content of programmes (this they argued helps to ensure that the right skills are taught for changing labour markets).

Allais (2014) critiqued the above approach, arguing that the economy cannot be a model for education and education should not be seen as a solution to economic problems. These neoclassical framings of education, she argued, reflect a lack of willingness to address wider structural economic and political problems facing society, and education is then left as the ‘solution’ to economic problems, when in fact other factors such as labour market conditions need to be addressed.

These perspectives have helped me to frame an investigation into the environmental qualifications currently available on the South African NQF. Qualifications remain a key leverage point into sector employment and are thus a critical systemic element in understanding environmental learning pathways. To understand the qualifications landscape, I studied data from the National Learner Record Database (NLRD) maintained by SAQA. I analysed the December 2012 NLRD and again in June 2013 due to changes in the database. In the NLRD analysis (see section 5.7.2), I identified and extracted environmentally related qualifications. The qualifications crossed a variety of sectors where environmental occupations are practised, and where environmental qualifications are being registered – mining, forestry, agriculture, nature conservation, and environmental science, demonstrating one dimension of the cross-sectoral nature of environmental education and training provisioning. Interviews were carried out with two key people in the South African Qualifications Authority (SAQA) who were responsible for registering qualifications on the NQF and for populating the SAQA database. These interviews were meant to establish how data on qualifications is collected, categorised, captured and monitored, and the associated challenges in the whole qualification registration process.

In the study of the NLRD qualifications database (as at 27 June 2013), of a total of 14 093 qualifications registered on the NQF, **896** of these (**6.4%**) were found to be environmentally related qualifications. These qualifications were found to be located across all 10 NQF levels with the bulk being registered at level 8 (234) and level 9 (224) followed by level 10 (89) (see Figure 6.3 below). Very few environmentally related qualifications are registered at lower NQF levels (between levels 1 and 4 there were 15 or less qualifications per level). Level 5 has the lowest number of environmentally focussed qualifications (only four). Generally, there is a gradual increase in the number of registered environmentally related qualifications as NQF levels increase (even though there is a drop from level 9 (224 qualifications) to level 10 (89 qualifications)). The increase is dramatic between level 7 (75) and level 8 (234). This shows high levels of specialisation at levels 8 (honours level) and level 9 (masters level). PhDs and doctoral degrees at level 10 generally tend to be specialised, but are not necessarily indicated as such on qualifications frameworks. The 172 TBA (to be announced) qualifications which used to belong to levels 4 to 7 pre-2009 had not yet been assigned levels on the new NQF at the time of this analysis.

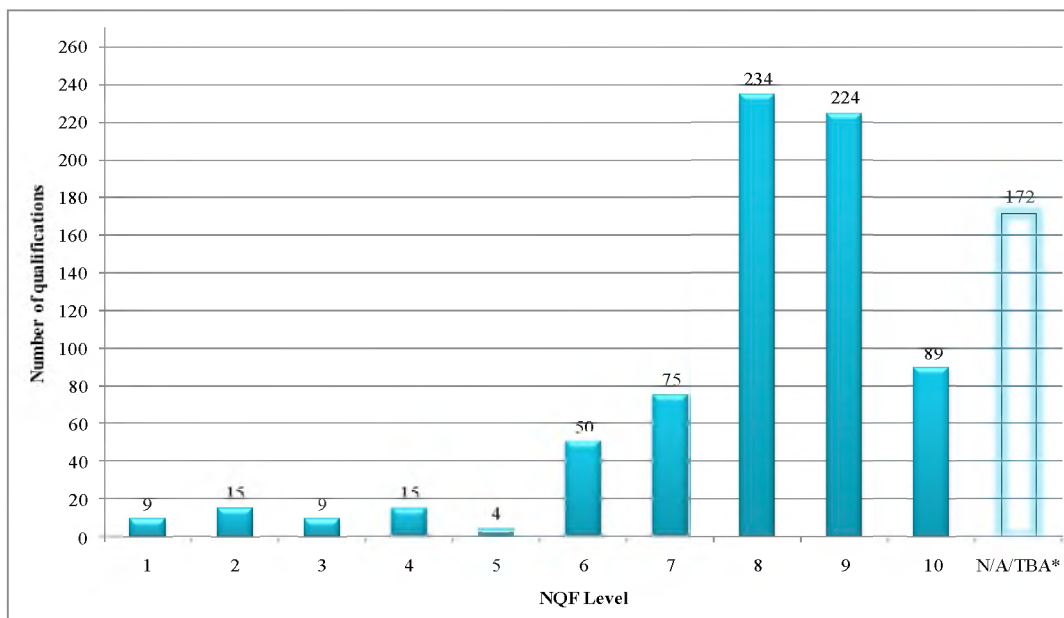


Figure 6.3: The distribution of environment/sustainable development qualifications across NQF levels (based on NLRD database analysis, July 2013)

Overall, the few environmental qualifications registered at lower NQF levels (1-5) reflect few options for learners interested in environmental and or green occupations. Up to NQF level 4, this could be explained by the dominance of the national certificates, the National Senior Certificate (NSC) and the National Certificate (Vocational) (NCV) which are more generic qualifications with specialist curriculum options or subject contents embedded within them⁵. Most learners studying at those levels register for either of these qualifications and the subject options they choose will be indicative of enabling progression into an environmental career or not. The system becomes very restrictive at level 5 (with only four registered qualifications as mentioned), which is the entry level into post-schooling (post-matric) education and training. While a considerable number of qualifications are registered at level 7 (75), which is equivalent to a three-year undergraduate programme, many learners entering the post-schooling sector do gain access into environmental qualifications at level 8 (honours degree programmes) and level 9 (masters degree programmes) reflecting a dominant postgraduate entry-point into the sector. Most qualifications at these levels are also designed for specialisation. From this analysis it is possible to see that 51.1% of the environmental qualifications reside at postgraduate level. There are therefore limited options for access or for alternate pathways into the environmental sector reflected by fewer qualification

options at level 5, if supply side specialisation at all levels is to be taken as an indicator of access into learning pathways.

A key implication of the scenario outlined in Figure 6.3 and discussed above, is that a learner that is unable to gain access to the traditional academic pathway will struggle to shape an alternative learning pathway or navigate into an environmental job. The data clearly depicts how qualifications shape who enters the sector, and where and at what levels. This is an issue of concern, as the DEA (2010a), for example, identified up to 30 000 entry level employees working in local government alone. Subsequent empirical research has shown that there are almost no learning pathways available for these workers in the environmental sector (Mohano, 2013). The DEA (2010) study noted that while Environmental Practices qualifications were available at levels 1-4 on the NQF, very few of these had been actualised in practice, showing too that qualifications alone are not the only factor shaping the learning pathways provisioning. This is also a concern given the status of scarcity of environmental technical occupations noted above in section 6.3 and in the DEA 2010 study.

From the qualifications mapping exercise that was performed to establish where these qualifications are located in terms of sub-fields, the results are as captured in Figure 6.4 below. In the figure, the sub-fields have been ranked in descending order from the one with the highest number of environmentally related qualifications to the one with the lowest.

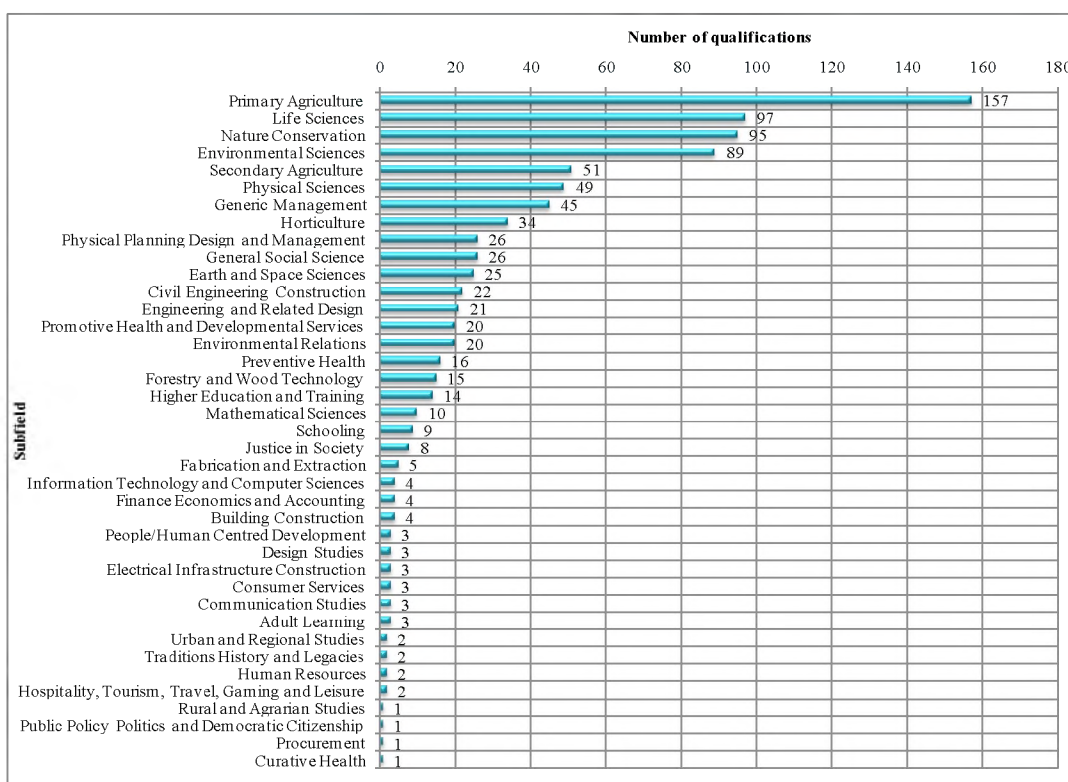


Figure 6.4: The distribution of environment/sustainable development qualifications across NQF sub-fields

The data shows that environment/sustainable development related qualifications cross a number of sub-fields of the NQF, including mining, forestry, agriculture, nature conservation, and environmental science, etc. Most qualifications are located in Primary Agriculture (157) followed by Life Sciences (97) with Nature Conservation, third (95 qualifications) and Environmental Sciences, fourth (89). Nearly 49% of the qualifications are located in these four sub-fields. The rest are spread out (albeit unevenly) across a number of sub-fields. Sub-fields with the least number of qualifications (one each) are Rural and Agrarian Studies, Public Policy Politics and Democratic Citizenship, Procurement and Curative Health. This distribution reflects the cross-sectoral nature of environmental education and training provisioning.

The location of most of the qualifications is Primary Agriculture. This is understandable given that in Primary Agriculture, there is direct use of natural resources and hence most of the qualifications will have something that is related to the environment. The same applies to nature conservation which ranked third. Generally, many qualifications are located in sub-fields that deal with environmental knowledge or application of knowledge in working with (conserving) natural resources or aspects of the environment. These are mostly in science disciplines. Fewer qualifications are found in social science and humanity sub-fields, for example, Justice in Society, Communication Studies, and Human Resources, to mention a few.

The data reflects a sector that has overwhelming access points at NQF levels 7 and 8 indicating that the system appears to be viewing environmental qualifications mainly as a specialisation and reflecting a dominant postgraduate entry-point into the sector. The data clearly depicts how qualifications shape who enters the sector, and where and at what levels. The emerging pathway picture is thus one that favours single, traditional academic pathway trajectories constraining broad access, mobility and progression.

June 2013 data from NLRD reflected limited qualifications currently on the Occupational Qualifications Sub-Framework (all set to expire in June 2016) but no data on possibilities of piloting new occupational qualifications. Data for General and Further Education and Training reflected a scattering of environmental qualifications in three defined sub-fields, Agriculture, Water and Wastewater and Mining.

This scenario of overemphasis on high skilled qualifications, thus constrains the emergence of a well-articulated provisioning system within the environmental sector by hindering the emergence of new or parallel learning pathways from technical into professional pathways and by not providing connecting points for artisan pathways. It also reflects a lack of safety nets for students on an academic path and little options for second chance pathways into the sector. This is an important point, too, given the large drop-off from the high numbers entering the Life Sciences, for example, who fail to graduate or enter postgraduate study and then cannot find employment (HSRC, 2009). This relates also to an as yet unsuccessful racial transformation project via improved education and training (since 1994) as the drop out and drop off is mostly among those with poor primary education and these are in the majority, black students (E. Rosenberg, October 4, 2013, personal communication).

Integral to a well articulated and integrated system is the emergence of parallel and second-chance pathways, which learners can use to move through quality education provisions from basic education through upper secondary education into higher education. Hoppers (2009) argued that they should be able to do this how, when and where they want to realise their chosen pathways.

The emergence of parallel and second chance pathways is critical for enabling access to disadvantaged and marginalised learners, and is a matter of concern for education and training systems in Africa, and in South Africa. The Association for the Development of Education in Africa (ADEA) conference in 2008 raised the importance of this within African deliberations on effective post-schooling systems (Hoppers, 2009). Broad access that caters beyond the 'privileged learner' (learner that gains easy access into higher education via quality schooling and adequate financial and system wide support) is an important consideration in a country with 3 200 000 out of education and work youth as reported by Cloete and Butler-Adam (2012) and discussed in section 1.2.2.

The data and discussion in this sector has illustrated that the vision of the South African NQF has not as yet been fully actualised in or for the emerging environmental sector. There is still a need to move away from provider-based options and there is a need to address the privileging of high skills clearly evident in the discussion above. There is need to consider possibilities for access into the sector via qualifications at lower levels of the NQF, and for possible parallel and second chance pathways into the sector as well as basic access into environmental learning pathways at worker level (Levels 1-4 on the NQF). This would be necessary if one were to also consider the point made by Death (2014) that the emerging green economy in South Africa should not be developed

in a way that perpetuates or furthers inequality; rather it should more fully encompass principles of social justice and access.

The next section considers another systemic niche area that has potential to enable or constrain the emergence of green skills learning pathways in South Africa and that also influences the emergence of multiple supply side opportunities. This systemic niche area relates to the way that the occupational system is structured, and it explores the occupational framing of environmental occupations in more depth.

6.5 Organising Framework for Occupations (OFO) analysis: defining of occupations

Occupations and the defining of occupations are a critical element in trying to understand learning pathways. As can be seen from many sectors other than the environmental sector (at present), underpinning seamless pathways is coherent occupational framing of sector based occupations and skills provisioning. For the environmental sector, both of these are dependent on a co-ordinated approach to representing occupations in the environmental sector in the official systems of occupational framing. The discussion below will introduce the South African occupational framework and detail my investigation of this framework. This work was necessary to enable a broad overview and understanding of how environmental occupations are framed within the education and training system. Here it should be noted that prior to this doctoral study, no other systematic analysis of the South African Organising Framework for Occupations had been undertaken to understand how environmental occupations were, or were not, being represented in this national system. The issue of a lack of insight into this system, and its significance for learning pathways provisioning was identified during the Environmental Sector Skills Planning Research (DEA 2010a) (which I participated in) where it was noted that little official data was available on environmental occupations in South Africa and that these were poorly defined in the national systems of planning and monitoring.

To develop the data and insights reflected below, I studied the occupational data captured within the South African occupational framework known as the Organising Framework of Occupations (OFOs). I analysed the OFO database and its evolution over three years and shared my observations from this data in various environmental forums (such as the National Environmental Skills Summit and the environmental sector's Human Resources Development network) and published a short article in the Environmental Learning Research Centre *Dialogue*. I then led a two-day workshop with colleagues from conservation organisations to explore further how

conservation organisations work with the OFO and the challenges they were experiencing. This represented the start of a more detailed exploration of the content and significance of the OFO and associated absences for the construction of learning pathways in this sector. Before discussing the data-based findings of this investigation, I provide more general insight into the OFO to facilitate interpretation and reading of the findings presented in this study.

6.5.1 What is the ‘Organising Framework of Occupations’?

The Organising Framework for Occupations (OFOs) is a “coded occupational classification system” (South Africa. DHET, 2012). Its emergence stemmed from the challenge of trying to find a common language and vocabulary to report, classify and describe occupations. Without a common language, it is possible to get data on supply and demand from the labour market but it is not possible to interpret and analyse the occupational data to understand the patterns and skills development implications. The OFO is thus a key tool for identifying, reporting and monitoring skills demand and supply in the South African labour market, and its categories are used for example in the Labour Force Survey and in the collection of national census data. At the time of the ESSP research in 2010, South Africa was refining the OFO so that its categories could be used for these national survey data purposes. The process of OFO analysis is discussed in section 6.7.2.

6.5.2 Background to South Africa’s OFO

To document occupational data (prior to the development of the ESSP), South Africa was using the South African Standard Classification of Occupations (SASCO), which was developed and adapted from the International Standard Classification of Occupations (ISCO-88) by Statistics South Africa. However, it presented a problem as it did not have enough detail to capture the nature of real occupations in South Africa. The National Skills Development Handbook (2011) reported that some of the challenges included: too few occupational groups, insufficient detail at levels 2-4 for effective skills planning, very little detail on occupational tasks and insufficient detail on intermediate stages of occupational development. This prompted South Africa to use and adapt the Australian New Zealand standard classification of occupations (ANZSCO) as it was a more up-to-date and comprehensive framework. Thus, from 2005 a locally adapted version of ANZCO was used by Sector Education and Training Authorities and the Department of Labour.

The local adaptation of ANZCO was called the Organising Framework for Occupations (OFO) (South Africa. DHET, 2012; National Skills Development Handbook, 2011). From 2005 to 2009 the responsibility for managing the OFOs and occupational data was spearheaded by the Department

of Labour. In 2009 this responsibility was transferred to the Department of Higher Education and Training (DHET). In 2010, the DHET decided during its annual updating of the OFO to realign more closely with the International Labour Organisation's (ILO) International Standard Classification (ISCO) version 8, which had been recently updated and aligned with the United Nations International Standard Industrial Classification (ISIC). This decision was an attempt to find a standardised framework in South Africa which would align more closely to the international framework. Thus, in 2011 the OFO 2011 was released and it reflected the occupational structure, definitions and tasks of ICSO-08. This version differed significantly from previous versions and it has helped to establish finally a coherent framework for South African occupations (South Africa. DHET, 2012; National Skills Development Handbook, 2011; South Africa. DoL, 2010).

6.5.3 The structure of the OFO

The OFO is constructed from the bottom up by analysing jobs and identifying similarities in terms of tasks and skills, categorising similar jobs into occupations and then classifying these occupations into occupational groups (South Africa. DHET, 2012).

It is important to emphasise the distinction made between 'job' and 'occupation' in the OFO: a job is a set of tasks or duties carried out by one person while jobs whose main tasks and responsibilities are so similar that they can be grouped together are clustered into occupations (South Africa. DHET, 2012). These occupations are articulated with an occupational descriptor and occupational tasks define the knowledge, skills and workplace experience needed to deliver the products and services linked to that occupation. Table 6.2 below presents the structure of one OFO as an example, which helps to illustrate the structural features of an OFO.

When clustering occupations into groups, two elements of skills are considered: skill level and skill specialisation. The skill level is an attribute of the occupation not the individual. It aims to reflect the typical range and complexity of occupational tasks and is generally judged by the amount of formal education, experience and informal on-the-job training. The OFO enables us to make a comparison between the "skills level of an occupation and the general education level associated with that occupation on the NQF" (Vorwerk, 2011, p. 3). This requires an expansive understanding of an occupation.

Greenwood (2008) outlined four areas that need to be reviewed when we look at skills specialisation in an occupation: 1) the field of specialised knowledge required; 2) the tools and machinery used; 3) the materials worked on or with; and 4) the kind of goods and services

produced. The concept of specialist skills is important as it enables development of a more nuanced idea of the dimensions of skills that need to be addressed when looking at greening occupational skills.

As can be seen from the example depicted in the table below occupations are grouped into major groups (1 digit code), sub-major groups (2 digit code), minor groups (3 digit code) and finally unit groups (4 digit code), which is made up of related occupations (6 digit code). Each unit group has a descriptor and allocated occupational tasks which help to orientate the key generic tasks served by this group of occupations. Each individual occupation has an occupational descriptor that describes the role of that occupation and alternative job titles that could be mapped to this occupation.

Thus, in Table 6.2 I have extracted all features related to the occupation of environmental manager. This enables a conceptual overview of the different structural features of the OFO as well as the type of information across the OFO that is available for employers, SETAs and the education and training system.

Table 6.2: Example of OFO – to illustrate scope of information provided

134901 Environmental Manager		
MAJOR GROUP	1 Managers	
SUB-MAJOR GROUP	13 Production and Specialised Services managers	
MINOR GROUP	134 Professional Services Managers	
UNIT GROUP	1349 Professional services managers not classified elsewhere This unit group covers managers who plan, direct coordinate and evaluate the provision of specialised professional and technical services and are not classified in sub-major group 12, business services and administration managers, or elsewhere in sub-major group 13, professional services managers. For instance, managers responsible for the provision of policing, corrective, library, legal and fire services are classified here.	Tasks include: Controlling administrative operations such as budget planning, report preparation, expenditure on supplies, equipment and services; Coordinating cooperation with other service provision agencies in the same or related fields; Developing, implementing and monitoring procedures, policies and standards for staff; Directing, supervising and evaluating the work activities of professional technical, clerical, service, maintenance, and other personnel; Managing budgets, controlling expenditure and ensuring the efficient use of resources; Monitoring and evaluating resources devoted to the provision of services; Overseeing the selection, training and performance of staff; Planning, directing and coordinating the provision of services

OCCUPATION	134901 Environmental Manager Plans, organises, directs, controls and coordinates the development and implementation of an environmental management system within an organisation by identifying, solving and alleviating environmental issues such as pollution and waste treatment in compliance with environmental legislation and ensures corporate sustainable development.

Alternative Titles and Specialisations:

Agriculture and Forestry Coordinator

Centralised Permits and Cites Manager

Conservation Science Manager

Contaminated Sites Manager

Environmental Education Manager

Land and Water Manager

Land Care Manager

Pollution and Waste Group Manager

Species Protection Manager

Wild Life Management Services Manager

Wild Life Protection Services Manager

Conservation Agriculture System Manager

Related to the OFO in South Africa is the National Occupations Pathways Framework (NOPF), which reflects progression pathways across the different major groups of the OFO. The NOPF clusters occupations into occupational families and occupational clusters to show occupational progression and articulation options (Vorwerk, 2011). These clusters provide information on potential progression pathways and assist occupational qualification developers to lay the foundation for vertical progression when developing occupational qualifications (Vorwerk, 2005; Vorwerk, 2011; Ndukula, 2012). There is also the long-term intention of this being the basis for career-pathing and human resource planning within organisations. Figure 6.5 represented below (Vorwerk, 2011) clearly depicts how the NOPF is intended to work and how well-developed occupational pathways can be represented showing opportunities and linkages for occupational progression. The OFO lays the systemic framework for occupational progression: occupations are grouped into occupational families (see Figure 6.5 below) and there are feeder occupations for particular occupations. The OFO thus lays a foundation for organisations and sectors to map and outline occupational progression, which is a critical element underpinning learning pathways.

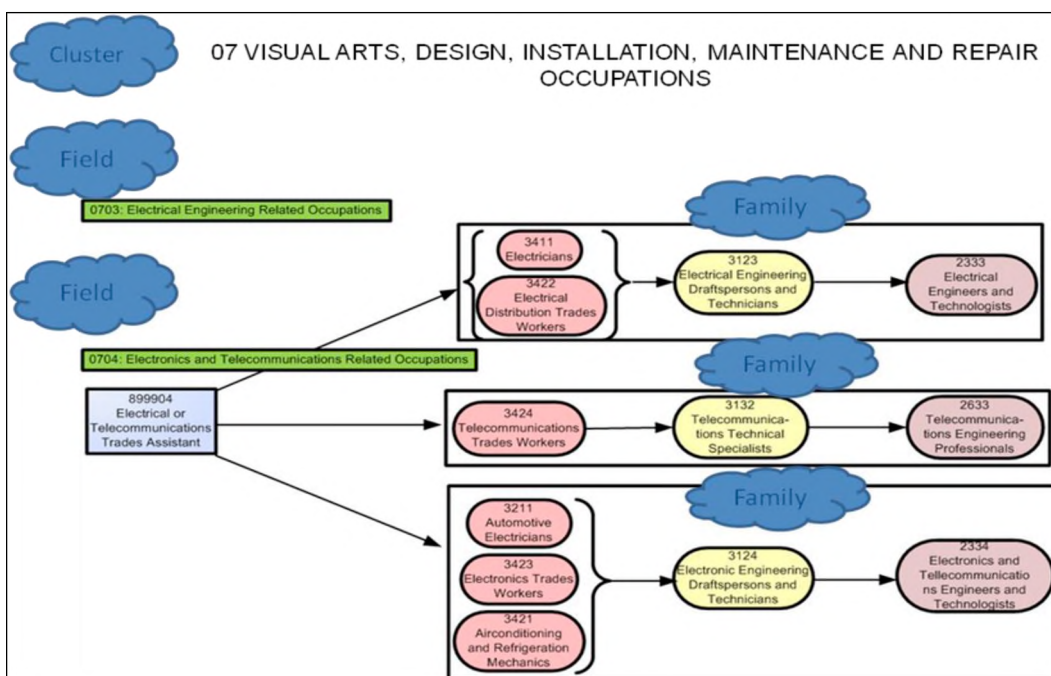


Figure 6.5: Depiction of occupational families as reflected on NOPF (an example of electrical engineering occupational families) (Ndukula, 2012; Vorwerk, 2011)

6.5.4 How the OFO is used

At a macro level the OFO has enabled standardisation and comparability. The use of a common language has enabled more coherent reporting across sectors and statistical analysis both nationally and internationally. It has enabled multiple government departments to standardise

how occupations are viewed e.g. Department of Home Affairs (immigration quotas), Department of Labour (scarce and critical skills tracking), StatSA (census) and Department of Higher Education and Training (development of occupational qualifications and awards). At a micro level, the OFO enables organisational skills planning and human resource planning involving skills issues such as recruitment and selection, induction, performance management, training programmes for individuals, skills gaps against required skills for an occupation, workplace skills planning, as well as enabling individual career pathways and occupational skills development (Vorwerk, 2011, Skills Development Handbook, 2010). The OFO framework thus creates the possibility for connecting macro and micro skills planning and development issues for development of a more coherent system that enables aggregation of occupational information.

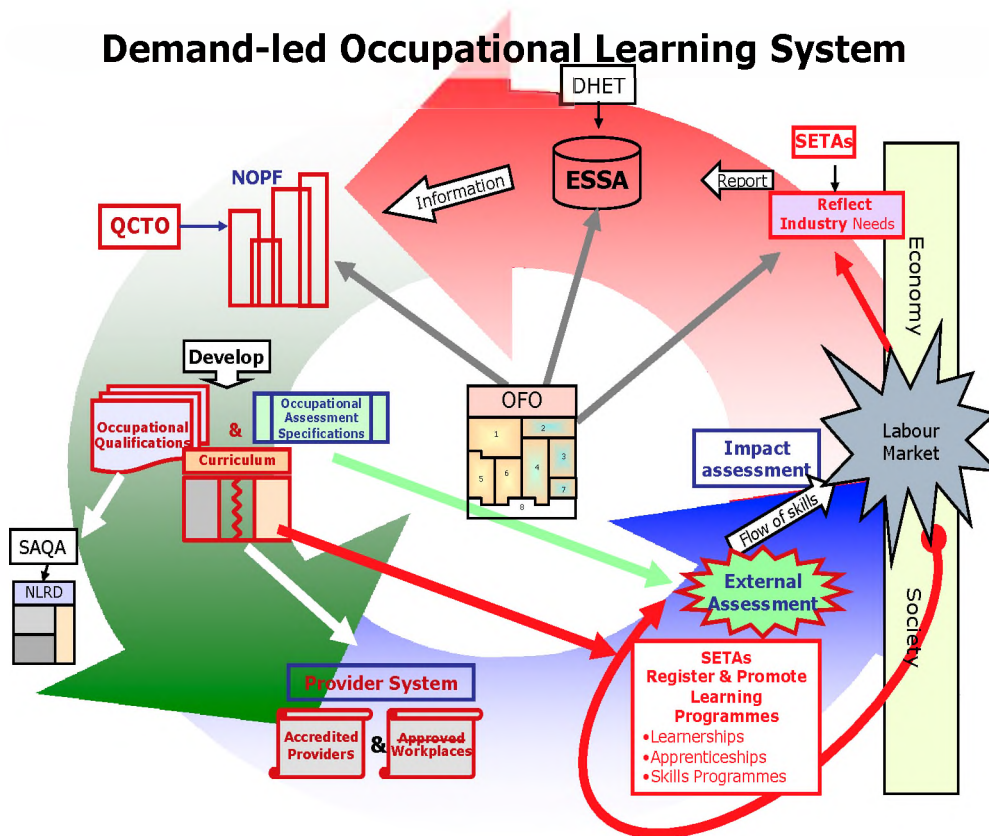


Figure 6.6: Occupational Learning System depicting role of OFO (from Vorwerk, 2011)

Figure 6.6 above illustrates how the OFO is central to occupational information and sectoral co-ordination around an occupation. The diagram illustrates that the OFO is used as a cross-sectoral tool to categorise all occupations; this enables the collection of coherent supply and demand information.

The labour market is the centre of the occupational system: it connects economy and society and enables skills planning and development that can potentially address broader socio-economic targets (e.g. unemployment). Various employers across sectors use the OFO to define job roles

and descriptions as they map their job titles and job descriptions according to the OFO; this enables them to report more effectively on their workplace skills planning. They report to their SETAs annually through workplace skills plans and annual training reports. The SETAs gather and aggregate data from workplaces and are able to report on supply and demand as well as scarce and critical skills using OFO categories. They utilise this information to develop their five-year sector skills plans, which unlock funding for various forms of training and skills development interventions. This information then feeds into the Department of Higher Education's systems that manage occupational information. The Employment Services South Africa (ESSA) is an information service and data capturing system for the supply and demand of skills. The National Occupational Pathways Framework (NOPF), as discussed above, is an occupational framework that enables the depiction of progression options and linkages within and across related occupational families (as depicted in Figure 6.6 above).

Accessing skills funding is another important role of the OFO. The National Skills Development Strategy III (South Africa. DHET, 2011c) requires SETAs to ensure they address skills needs within their sector. SETAs will not be able to fulfil their mandate if they do not articulate their skills development requirements in terms of occupations, which in turn will lead to the development of occupational qualifications. Education, training and capacity building for specific work outputs are being developed through the Quality Council for Trades and Occupations whose defined processes for developing qualifications also depend on the demand for qualifications being stated in terms of occupations. Without an OFO code, it is difficult to track what occupation is being supported, as it is not possible to fund or provide for an 'occupation that does not exist'. This explains the significance of the OFO work for the environmental sector, as reported above, the DEA (2010a) found that environmental occupations were poorly represented in the national systems of occupationally based skills planning and monitoring.

To understand the role of the OFO in occupational learning, I participated as a participant observer in the core group responsible for developing qualifications for Training and Development Facilitators. Within this core group we spent extensive hours analysing the OFO, examining the core services that some within the occupation would offer and the knowledge and skills required. Each occupational task was analysed and tracked for various levels of skill. From these engagements, as well as from the OFO system analysis presented above, I identified that the OFO is thus central to the development of occupational learning pathways.

I have tried to show in this discussion that the information on the OFO is critical as it is a central determinant on how information about occupations is gathered and reported across the system. It is also a key determinant for making occupations 'visible' within the national skills system planning, funding and monitoring set up, and more so if the occupations are spread across sub-fields and sub-sectors (as outlined above) as is the case with environmental occupations.

6.5.5 Reflecting on the emergence of green occupations in the OFO

This section will report on the OFO analysis that I conducted in this study. I first analysed the OFO for environmental occupations in June 2010 as the ESSP research was being concluded and as we realised the critical problem with occupational representation in the sector. This was needed at the time to inform ongoing engagement with SETAs on green skills as the post-ESSP process of engagement led by myself, members of the ESSP research team and the Department of Environmental Affairs which identified that SETAs were highly reliant on accurate occupational codes for their skills planning (South Africa. DEA, 2010b). My initial OFO research therefore informed some of the earlier post ESSP engagements with SETAs, raising further need for more in-depth analysis, particularly also following the switch to ISCO-08 and the substantial changes to codes in 2011. I was therefore compelled to redo this analysis in 2011 and 2012. My observations thus have been framed across these analyses. The discussion below will highlight some of the critical issues that underpin green occupations within the OFO.

There has been substantial change in the representation of environmental occupations within OFO frameworks. In June 2010 when I first analysed the OFO database, it was impossible for me to filter out environmental occupations, as not many existed as independent occupations. I had to go through the database line by line (there were about 14 000 entries of job titles) to search for environmental occupations. Most at that stage were listed as alternative titles. The DHET (2010d) reflected that the most comprehensive unit group was that of Environmental Scientists (2343) located at skill level 5 (Datasheet O1); this unit group contained occupations such as Conservation Officer; Environmental Consultant; Park Ranger and Environmental Research Scientist. The Environmental Manager (139902) was another occupation featured and others at skill level 5 were listed as alternative titles. These were Environmental Planner as an alternative title in Urban and Regional Planner; Environmental Engineer as an alternative title in Chemical and Civil Engineering; Environmental Technologist as an alternative in Chemical and Civil Engineering Technologist; and Environmental Economist in Economist. At skill level 4 there was only one occupation –

Environmental Science Technician. There were no occupations listed at skill level 3 and at skill level 2 there was only one, which was the Environmental Practices Inspector. At skill level 1, the only occupation that can be regarded as environmental was the Recycling or Rubbish Collector (899601). These formed the basis of the environmental occupations that were captured within the OFO in 2010 and 2011. The inconsistencies in terms of scope of occupations listed, the reflected narrow occupational differentiation and poor representation across levels of skills were highlighted as key issues at the time. This analytical work undertaken for this PhD study was fed into various environmental skills processes (South Africa. DEA, 2010d; FN12; FN13) and feedback was given to SETAs through a meeting organised by the Department of Environmental Affairs (DEA) where I presented some of my observations. I was also able to present this analysis to a member of the national OFO committee convened by DHET. These interventions, prompted by DEA and the National Environmental Skills Planning Forum, have had a significant impact on the refinement of the OFO framework.

Consequently, the OFO framework released in 2013 was substantially different with growing representation and recognition of green skills. A careful study of the most recent OFO (South Africa. DHET, 2013c) reflects a growing emergence of new environmental occupations as compared to earlier versions as well as a very clear upfronting of environmental occupations within the OFO. The 2013 OFO draws on the American Standard Classification of Occupations to define and categorise 'Green' occupations. The 2013 OFO makes the distinction between Green Occupations and Occupations needing green skilling. Green occupations, of which there are 96 now listed in the 2013 OFO, can be described as follows:

Green occupations have as their direct purpose the nationally identified priorities and initiatives of reducing negative environmental impact and contribute sustainably to environmental, economic and social sensitive enterprises and economies. This includes occupations with descriptors that directly reflect and contribute to the maintenance of processes related to national initiatives to:

- Develop and adopt renewable sources of energy
- Reduce consumption of energy, fossil fuels and raw materials
- Enhance energy and resource efficiency
- Reduce greenhouse gas emissions
- Decrease waste and pollution
- Recycle materials
- Prevent the loss of biodiversity and restore ecosystems. (South Africa. DHET, 2013c, p. 12)

Despite this reflected progress it is critical to note that we were not able to source aggregated data on environmental occupations in South Africa, hence the need to draw on the American Framework. Although this has been useful in upfronting green occupations it has also resulted in several issues identified in further analysis for this PhD study, including the following (FN 10, FN12, FN4, DS03):

- Game Ranger (which is actually not an occupational title used in South Africa which uses 'Park Rangers') is classified as a skill level 5 professional occupation. South Africa has approximately 3 000 Park Rangers employed in national and provincial parks that do not have a Grade 12 qualification (as South African conservation organisations are committed to drawing labour from neighbouring communities). These individuals cannot be mapped to the existing occupation and no intermediary or lower skill occupation exists.
- Environmental Engineer (which was added from the international framework) has no designation currently in South Africa apart from a specialisation of Civil Engineers thus the sector was unprepared and unaware of how to respond to this occupation (see discussion in Chapter 7).
- Some environmental occupations have emerged organically, and hence continue to operate from the periphery of the education and training system e.g. Environmental Educator which is an established community of approximately 2 000 employees in South Africa. This, however, remains an uncategorised occupation. Environmental Educators need combination skills from the sub-fields of Environmental Sciences and Education. Thus two patterns of emergence are observed in the OFO framing of this occupation: officially some regard them as miscellaneous educators and some regard them as an alternative specialisation of an environmental manager (see Table 6.2). This has subsequently resulted in a split in terms of where the occupation could be located with the Conservation SETA (CATTHSETA) or within the Education, Training and Development Practices SETA (ETDP SETA). Within the transitioning system, sector initiatives have hence endeavoured to apply for two differentiated occupations,
 - *Environment and Sustainability Practitioner (CATHSETA)*
 - *Environmental Training and Development Professional (ETDPSETA)*

However, this application process has not yielded any success in the last two years (FN 10, FN12, FN4, DS03) affecting the provisioning of training for this occupation, especially at entry level which in the past has provided for environmental education in community education contexts.

Owing to the 'newness' as well as the lack of a co-ordinated approach to environmental occupations, there is very little available knowledge on the profile of environmental occupations and systemic integration of these into broad occupational frameworks. This has resulted in huge contextual variance in occupational titles, occupational tasks, entrance requirements and general sectoral knowledge of an occupation, which has created difficulty in finding a common language or reference framework for discussions on employment trends and statistics in the sector, as was also found to be a problem in the ESSP research. Current occupational listings are, in addition, very operational which requires a strategic review with futuristic perspectives that is currently absent.

In the 2013 OFO, new emerging occupations, e.g. Environmental Impact and Restoration Analyst and Environmental Engineer are reflected mainly at the high skills / professional levels. What emerges is a picture of a highly skilled sector, and there is fairly extensive coverage of highly skilled professional occupations reflecting growing specialisation in the environmental sector (South Africa. DHET, 2012). However, how these are being assimilated and catered for within the sub-sectors, which are still emerging as reflected in the discussion on environmental engineers in Chapter 7 and in the discussion on Environmental Scientists in Chapter 8.

Of concern, however, is the fact that in the 2013 OFO, there is still **very little representation of environmental occupations at intermediate and elementary skill levels**. Environmental occupations appear scattered and are not visible across levels of skill. The occupational descriptions and titles listed under Environmental Science Technician (which is the primary environmental occupation in the technical major group) suggest unclear connections to higher and lower skill levels. This reflects an imprecise picture of feeder occupations (currently the only possible feeder elementary occupations listed are Rubbish Collector, Refuse Sorter, Waste Material Sorter or Environmental Practices Inspector) into the environmental technician occupation and there are unclear linkages into professional occupations e.g. Environmental Scientist. On NOPF the Environmental Practices Inspector (skill level 2 occupation) is mapped to Environmental Manager (skill level 5) without any intermediary options. In the career pathing within a provincial park, the Environmental Technician (requires a National Diploma according to organisational career paths) is career pathed to an Environmental Scientist (which requires a master's degree according to the organisational career paths). Thus it is possible to see the carryover of this problem into human resources practices within workplaces (ECP Int).

This reveals a poor knowledge of the systems of practice at intermediary occupations levels and

poor occupational differentiation. Discussions at practice level reveal that there is as yet, a poor knowledge of the scope of occupations at this level⁶ so they are often mapped incorrectly by human resource personnel. When viewed comparatively against more established sectors like Agriculture, and the proper occupational differentiation depicted, for example, by the occupation of farmer, all occupational differentiations are listed with independent OFO codes:

- Agronomy farmer
- Field and vegetable farmer
- Tree and shrub farmer
- Aboricultural farmer
- Ornamental horticultural farmer
- Mixed crop farmer
- Livestock farmer
- Dairy farmer
- Poultry farmer
- Insect farmer
- Game farmer
- Aquaculture farmer

All the above represent only a snapshot of the occupational range of farmer as listed in the OFO (South Africa. DHET, 2012) (e.g. there is a whole range of subsistence farmers, crop farmers etc.). What is important about this is that this clear differentiation enables a sector to plan and plot clear connections within occupational families; it enables better human resource practices in terms of career pathing and enables collection of coherent labour market information. One may also see from the comparison with Agriculture, that it is possible to develop clearly differentiated occupational descriptions within a sector, and that this is indeed being done in sectors other than the Environmental sector in South Africa.

These disjunctures raise further concerns when viewed on NOPF – the absence of clearly differentiated technical and elementary occupations reflects loose, unfocused occupational progression pathways e.g. Environmental Practices Inspector (skill level 2 occupation) is mapped to Environmental Manager (skill level 5) without any intermediary options. Unlike the examples depicted above and which I examined in other sectors, such as mining and agriculture, environmental occupations reflect discontinuous pathways.

An issue that has also not been addressed is the poor representation of social-ecological

⁶ Workshop observations of ten days of the Environmental Sector Human Resources Development Network workshops

occupations, this is despite the environmental sector being recognised as an inter-disciplinary sector and the environmental sciences essentially being oriented towards social-ecological systems approaches (Steffen et al., 2011) and national policies requiring social-ecological responses to environmental concerns (e.g. the National Climate Change Response White Paper of government, RSA 2011). Many environmentally linked occupations currently represented are scientists requiring a science learning pathway. Occupations linked to community conservation, social ecology, stewardship, rural development, climate change adaptation etc. are not represented on the OFO. This restricts visibility and opportunities for movement for students with a social sciences pathway.

Throughout my investigation, the systemic knowledge and flow of information from labour market (employers) was found to be problematic. The flow of information from employers through workplace skills plans into sector skill plans into a framing of systemic information is a process which has inherent flaws (this process is explained in greater detail in section 6.8.)

In a system that is trying to respond to education and training needs from labour market perspectives, the 'language of occupations' has become the dominant code of meaning within the Occupational Qualifications Framework. It holds power in that resources, qualifications development and skills planning are centred on the language of occupations. Identifying absences such as those identified above start to intensify concern around systemic articulation within an occupationally driven system of skills development, and are critical to address if meaningful learning pathways as envisaged by the DHET (2012) are to emerge for this new area of economic development and social-ecological practice in South Africa. As indicated in the DEA (2010a, 2010b) study, environmental learning pathways are not only necessary for economic development within the green economy framework, but are also essential to the public good, as they are required to manage South Africa's natural resources and biodiversity sustainably for current and future generations as outlined in the South African Constitution (South Africa, 1996).

The above discussion has allowed me to explain that central to understanding occupational progression is an understanding of how occupations are framed, how they are represented and how it may be possible to plot/explore or understand occupational hierarchy and possible progression, within a framework viewing pathways as a laminated totality.

The data presented and discussed here suggests that a key starting point for addressing the need for improved learning pathways for green skills or environmental jobs in the sector involves:

- 1) clarifying environmental occupations by getting accurate reports received from employers on the demand and supply of jobs;
- 2) consolidating information on environmental occupations that can be mapped to the OFO and used to correct erroneous mappings as outlined above;
- 3) comprehensive representation of environmental occupations on the OFO based on clear descriptors of differentiated occupations and associated progression pathways (as is the case in other sectors such as agriculture and mining); and
- 4) ensuring availability of different education and training options within a more co-ordinated systemic framework for green skills development and that addresses the imbalance between existing high skills and the rest of the skills system.

A more coherent co-ordinated approach that is inclusive of the above processes will potentially assist existing environmental practitioners to meet their skills development needs and enable easier pathways for new entrants to the sector. Recommendations to this effect are made in Chapter 9.

However, besides the systemic niche area of qualifications and occupational differentiation, there are other systemic niche areas that require investigation for green skills learning pathways construction. I discuss upskilling via a short course culture next, which was also identified as characterising the South African green skilling system in the DEA's ESSP research (South Africa. DEA, 2010a) but which required further examination within a learning pathways framework.

6.6 Upskilling – short course culture

Environmental employees are constantly faced with new challenges in old jobs. These new challenges relate to increased environmental degradation, growing mandates and decreasing budgets and capacity to respond, new legislation with inadequate capacity to implement it, and new concepts, processes and technologies as well as new issues. The demand for skills upgrading is also related to inadequate quality and relevance of provisioning in the existing qualifications streams (South Africa. DEA, 2010a). Practitioners, for example, report that environmental management degrees are too 'theoretical', and there are inadequate linkages between what is taught in courses and what happens practically on the ground (South Africa. DEA, 2010a). Rosenberg (2013) proposed the need for 'T-shaped professionals' with depth in one area and breadth in another.

Short courses have been used to ‘upskill’ or ‘keep up’, and there is an ongoing proliferation of these in the sector (South Africa. DEA, 2010a) as also discussed further in Chapter 6 and 7 in the two case examples. Few of these environmental skills programmes are funded or supported by SETAs as reflected in Sector Skills Planning and as also reported in the ESSP research (South Africa. DEA, 2010a). Elementary occupations seem to be relatively neglected in terms of environmental skills development as shown in the data above, and as also found in related empirical studies (Mohano, 2012; Maphinyane, 2013; Fourie, 2014; Burger, 2014). Short courses are so widely utilised in the sector that one can describe the sector as being characterised by a ‘short course culture’. It appears to be the only mechanism for development of new skills in the sector (South Africa. DEA, 2010a). The following graph based on research undertaken for the ESSP in 2010 (Figure 6.7) illustrates this.

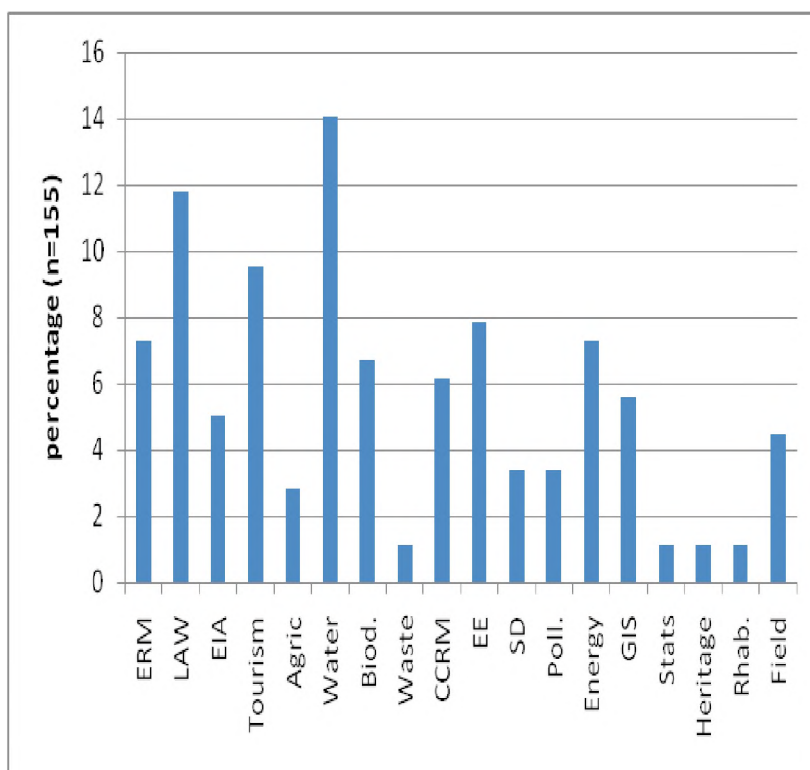


Figure 6.7: Short courses offered in environmental sector (sample of 155 environmental short courses), according to broad categories (South Africa. DEA, 2010a)

ERM – Environmental risk and management

Law – Environmental law, compliance and enforcement

EIA – EIA, SEA, SIA, public participation

Tourism

Agric – Environmental agricultural, soils

Water – Water, wetland, coastal and marine

Biod. – Biodiversity, ecology, geology

Waste – Waste management

CCRM – Community, conservation, resource management

EE – Environmental education
 Poll. – Pollution (air, water), environmental chemistry
 Energy – Renewable energy
 GIS – Geographic information systems
 Stats – Environmental statistics
 Heritage
 Rehab. – Rehabilitation
 Field – Field assistant, ranger

Understanding that occupations will undergo substantial changes in the transition to a green economy is critical, as also reported in international studies such as that undertaken in the European Union for CEDEFOP (2013) reporting and in International Labour Organisation studies on Green Skills (2011). All these changes will have skills development implications. The depth of the training needed will be proportional to the extent of skills change. Firstly, there will be qualitative change where an increased demand is observed in some occupations; this will require increased training in existing occupations (ILO, 2011a). Changing established occupations will require on the job training or short course training. New and emerging occupations will require initial degrees/training and longer term formal learning programmes (ILO, 2011a).

The ILO (2011a) has provided a framework for understanding the type of skilling intervention that will be required in the transition to green economy, shown in Table 6.3 below.

Table 6.3: Training needs for changing and emergent green occupations (ILO, 2011a)

Degree of Skill Change	Occupational Change	Typical Skills Response
NONE	None or only quantitative	None or increased training in existing occupation
LOW	Changing established occupation	On-the-job learning or short training courses
MEDIUM	Changing or emerging occupation	Short courses or longer continuous training
HIGH	New and emerging occupation	Initial training, university degree or longer continuous training

Reflecting on the extensive skill needs outlined above will require coherent articulation between environment and skills development systems to ensure that they remain responsive to the rapidly changing work and job roles.

Landscape and subsequent regime tensions (which in this case is education and training systems) may therefore create the space within which skills development to support the transition to a green economy can develop successfully.

International experience from the G20 training strategy for a Green Economy (ILO, 2010) reflects that to gear up education and training systems for effective skills development systems, some simple elements need attention:

- Anticipate skill needs;
- Engage employers and workers in decisions about training provision;
- Maintain the quality and relevance of training;
- Make training accessible to all sectors of society;
- Ensure viable and equitable financing mechanisms; and
- Continuously evaluate the economic and social outcomes of training.

(OECD, 2014, p. 37)

The discussion in this chapter highlights that a successful transition to a more sustainable society requires proactive steps that facilitates effective education and training responses, which better match the needs of changing labour markets as well employers-led demand for skills.

Collaborating the findings of DEA (2010a) green skills development in South Africa is not only reactive the systemic responses as the education and training system gear up to support the transition. Provisioning appears somewhat disjointed as displayed by the analysis of occupational information as well as qualifications. Niche activities may break through to the mainstream if they successfully solve bottlenecks in the extant regime (Gibbs & O'Neil, 2014).

The next niche element presented below is sector skills planning and analysis, this is a critical element to engage employers and workers in decisions about training provision and sector greening.

6.7 Sector skills planning analysis

The National Skills Development Act 97 of 1998 with its associated amendments provides the institutional framework for a “national strategy to develop the skills of the South African workforce” (p. 255). section 9(1) of this Act makes provision for the establishment of Sector Education and Training Authorities (SETAs, see also section 3.2.2.2 where these were introduced).

The Act decrees that a SETA is responsible for a 'national economic sector'. The Minister determines what constitutes discrete sectors against criteria established in the above Act. SETAs play a significant role in "gathering statistics and other relevant information skills needs and training provision", and as noted above they do this using occupational categories relevant to their sectors (South Africa. DHET, 2010d p, p. 12). Every five years a National Skills Development Strategy is developed by DHET to guide the work and prioritisation of skills development initiatives of SETAs. In the period of this research, South African SETAs were implementing NSDS III (the third National Skills Development Strategy implemented since 1994). SETAs take guidance from the NSDS programmes for prioritising their skills development planning, which is then aligned with sector-based priorities allowing for nationally aligned sector skills programmes.

6.7.1 What are sector skills plans?

The Skills Development Act also decrees that one of the main purposes of a SETA is to develop a Sector Skills Plan (SSP), a process which takes place every five years, with annual updates. Employers submit Workplace Skills Plans and Annual Training Reports to SETAs. SETAs utilise these together with sector research and economic reports as well as education and training reports. SSPs are compiled using the Workplace Skills Plans (WSPs) and Annual Training Reports (ATRs) and other skills intelligence gathered by the SETAs. The WSPs provide the status of a firm's workforce against both an equity profile and an occupational breakdown. The ATR is a report of actual training conducted against the training planned by the firm, submitted at the end of each year to the relevant SETA. The WSPs in particular identify skills shortages at the firm level and these, together with other sectoral studies, indicate the scarce skills within a specific sector and the economy as a whole (Goga & Van der Westhuizen, 2012).

The Sector Skills Plans are five-year projections which analyse the labour market within a sector and are meant to provide a comprehensive picture of the skills landscape in a sector.

The Sector Skills Plan:

- Provides the profile of the labour force within the sector by province, race, age, gender, qualification and occupational category;
- Monitors the supply of, and demand for labour within the sector;
- Tracks the absorption of new labour market entrants into the sector;
- Identifies areas of skills growth and skills need; and
- Identifies opportunities and constraints on employment growth in the sector. (Services SETA, January 2014)

The SSPs are important skills planning mechanisms; they form the key strategic analysis guiding the implementation of training and skills development within the sector, and associated funding allocations. They provide signals to the education and training system, providers and sector employers on skills needed or those that will be needed in the future economy. The capacity of SETAs to undertake green skills research in their sector is therefore a key determinant of supply side interventions for green skills learning pathways development.

6.7.2 Provisioning for Green occupations in Sector Skills Plans

The broad and cross-cutting environmental 'sector' has neither a dedicated SETA nor organised industry bodies to drive skills development. As a cross-sectoral concern, environmental skills planning was meant to be integrated across all SETAs (South Africa. DEA, 2010a; South Africa. DEA, 2010b; HSRC, 2009). However, a short study by Lotz-Sisitka, Malema and Olvitt (2004), involving a desktop review of five SETA Sector Skills Plans (SSPs), highlighted that SSPs were being developed without giving adequate attention to the skills requirements associated with sustainable development policy and legislation relevant to the sector. The flow of skills info from employer to SEAT into sector is represented in Figure 6.8. below. This study also noted that there were varying interpretations of environment and sustainability issues in the SSPs that were not consistent with those in the National Environmental Management Act of 1998. This was corroborated in 2010 when the Department of Environmental Affairs led a process to review a much broader selection of SSPs as a key implementation activity arising out of the ESSP research (South Africa. DEA, 2010a; 2010b) as at the time, new SSPs were being developed and the ESSP had identified engagement with SETA SSPs as a critical process for enhancing the green skills development system in South Africa (South Africa. DEA, 2010a). This initial post-ESSP research (South Africa. DEA, 2010b) revealed that environmental occupations were still not receiving sufficient attention within SSPs. From this analysis an enabling document was produced which provided SETAs with a brief overview of each of the key green skills interventions within their sector (South Africa. DEA, 2010b). I was actively involved in the production of this enabling document as well as in facilitating a workshop of SETAs where we presented an analysis of green skilling, the observations from my OFO analysis (referred to above) as well as recommendations for SETAs. The SETAs reflected on the usefulness of the information, as many had struggled with understanding how to integrate environmental provisioning into their sector (FN,3).

For this thesis I have reviewed the 2013 SSPs from a selection of SETAs (CATTHSETA; Energy and Water SETA; Local Government SETA; Mining SETA; and Agriculture SETA) to provide further

perspective on this issue. I reviewed these five SSPs as they have a fairly direct link to the environmental sector and thus present as 'critical cases' for examination of SSP development (there are 21 SETAs in total). This sampled analysis forms the core data that informed the discussion below.

6.7.3 Training provisioning

SSP data for the Energy and Water SETA (E&WSETA, 2013), despite illustrating a need for technical and high skills, reflected that in the 2012 annual training cycle, 257 085 non-accredited short skills programmes were recorded within the sector and in the 2013-2014 cycle, the WSP training indicated a further 59 613 intended training programmes. The allocation for accredited formal learning programmes in identified high skill areas is negligible compared to these figures. The logic behind a formally constituted skills system with an official mandate to support accredited training supporting non-accredited training at this level is puzzling. In a sector with a critical need for technical skills this "over-emphasis on non-accredited, short course training" (E&WSETA, 2013) reflects a serious anomaly. It raises a number of questions: Who are the providers of the training? Why are employees choosing non-accredited courses? Does this indicate an absence of accredited courses? How is quality maintained across these courses? These questions are important when reflecting on the choices individuals and employers are making.

The Mining Qualifications Authority (MQA) SSP of 2013 (MQA, 2013) reflects a very strong intent to address environmental issues and risks in the background sections; there is however very little carry through into direct, tangible green skill interventions. Various green skills occupations are listed as scarce skills requiring interventions. There were however some curious omissions. The need for robust environmental management in planning mining activities cannot be overemphasised as per the Minerals and Petroleum Resources Act (Act No.28 of 2002) requires holders of mining rights to submit a Social and Labour Plan (SLP) for approval by the Department of Mineral Resources (South Africa. Department of Mineral Resources [DMR], 2011). It is therefore of concern that the following scarce skills were not mentioned as needing intervention: environmental engineer, environmental engineering technician, environmental manager, environmental technician and environmental assessment practitioners. A study by Maphinyane (2013) showed the same trend; DME requires certain environmental practices in the industry (e.g. rehabilitation) yet little attention is being given to these legislative requirements by the MQA, leading to inadequate training responses in the sector affecting legislative compliance. Maphinyane's (2013) study showed too that this affects learning pathways into rehabilitation

practices in key occupations in the mining sector, which is also exacerbated by poor definition of rehabilitation related occupations in the mining sector (refer to the discussion on the OFO above). A recent study being undertaken for the MQA (Rosenberg, 2015) is the first of its kind taking a value-chain and macro-economic approach to identification of green skills needs in the mining sector to establish a more robust approach to demand side analysis for green skills. Few other sectors have adopted this kind of proactive skills planning approach to sector-based green skills development at present, which indicates a lack of appropriate methodological approaches for green skills research at SETA level. This has been identified as a national need and a Green Fund Project focussing on green skills system capacity development has recently been funded by the national Green Fund to address this kind of weakness in the systems of skills development (National Environmental Sector Skills Planning Forum [NESSPF], 2014).

The discussion below illustrates further how skills information flows through the education and work systems and also how occupations in high demand are identified by the DHET and provisioned for.

6.8 Scarce skills list

Skills shortages will hamper the transition to a green economy as they reflect underestimation of growth and labour demand. Skills information that captures future growth, occupational demand incorporating both expansion demand as well as replacement demand is urgently required in the environmental sector as is shown by attempts to provide such information by the DEA (2010a), the HSRC (2009), the GreenMatter for the biodiversity sub-sector (2012) and the DST for the waste sub-sector (2012), and the DHET for the government's structural integrated programmes (South Africa. DHET, 2013b). Ideally the National Scarce Skills List should capture this sector related information, as it remains a critical mechanism for spearheading and understanding skills shortages, and for responding to provisioning needs at a national level. The list provides an overview of scarcities in the economy linked to different occupations. The list was intended to serve the following functions according to the foreword prepared for the first list by the Department of Labour in 2006:

- For the Department of Labour and its statutory skills development intermediaries, the national list provides a set of indicators for skills development interventions
- For the Department of Education and public education and training institutions, the national list provides a set of indicators for course development and career guidance that should be provided to learners and communities, including schools, FET Colleges, Universities, Universities of Technology and learners across these institutions

- For the Department of Home Affairs, the national list provides a basis for establishing the Work Permit Quota List and for evaluating employer-sponsored applications for work permits
- For the national government and national initiatives such as JIPSA (Joint Initiative on Priority Skills Acquisition), the national list begins to provide a platform for targeted interventions and the development of mechanisms to monitor and evaluate both the success and impact of measures aimed at redressing particular scarcities. (DoL, 2006, p. 3)

The Department of Labour also provided a definition of scarce skills as follows: **Scarce skills** refer to occupations in which there is a scarcity of qualified and experienced people currently or anticipated in the future either because such skilled people are not available or because they are available but do not meet employment criteria (South Africa. DoL, 2007). Scarcity can be absolute or relative: **absolute scarcity** is where suitably qualified people are not available (new emerging occupations, where there are few people available with required skills – which could be a combination of qualification and experience). **Relative scarcity** is when skilled people are available but they don't meet other employment criteria, equity considerations, or the geographic location of work.

This section outlines the processes of information flow that feed into the development of the scarce skills list. The scarce skills list is developed primarily from information from sector skills plans (SSPs). This information is complemented by information gleaned from government departments – Department of Home Affairs (DHA), the Department of Trade and Industry (DTI), the Department of Public Enterprises (DPE), and the Department of Science and Technology (DST) – as well as information gleaned from commissioned sectoral research studies (Goga & van der Westhuizen, 2012).⁷

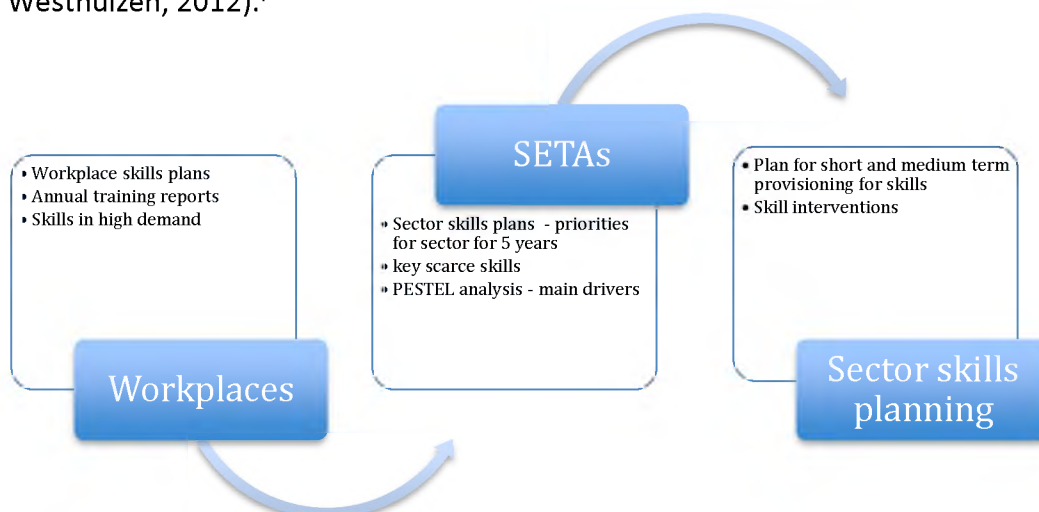


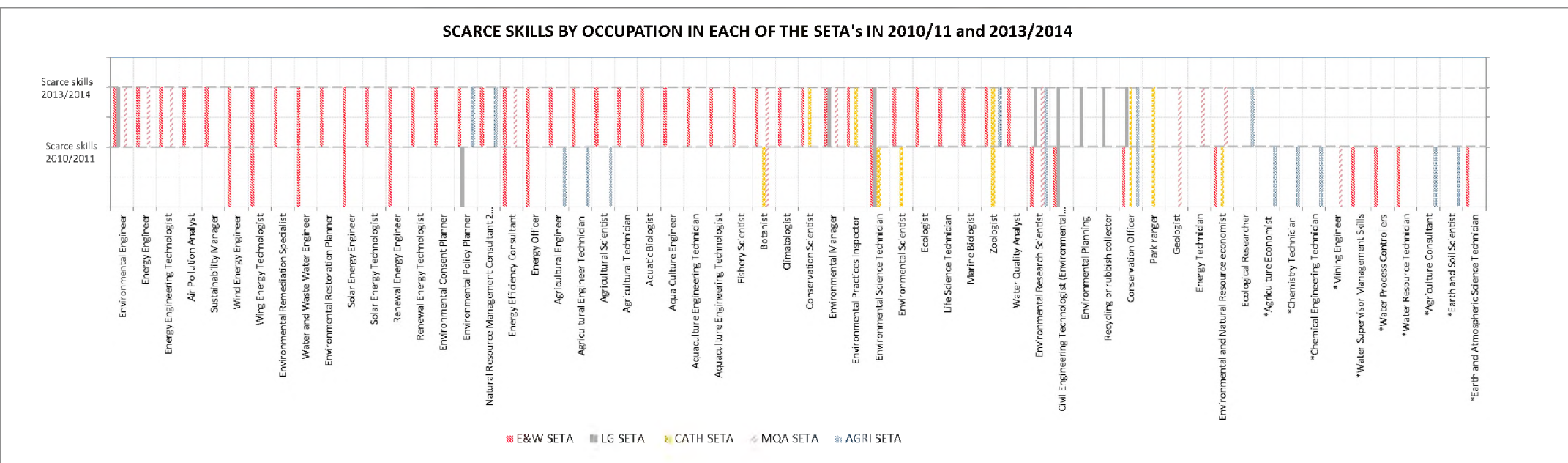
Figure 6.8: Flow of sectoral skill information

⁷ A PESTEL analysis looks at macro level political, economic, social, technological, environmental and legal drivers of change in a bound context.

South Africa utilises a labour market information system that involves SETAs undertaking sectoral research and consultation, which is then amalgamated into this National Scarce Skills List. The information system is thus hugely dependent on the quality of the sectoral data from SETAs (see Figure 6.8 above). There are several challenges related to this data generation at SETA level; the most pressing in the context of this study is a lack of clarity about environmental occupations or environmental specialisations. Environment / green skills (as discussed above) are multi-sectoral, and are spread across multiple SETAs, but are seen as core occupations to many – hence there is no common understanding on how job titles are mapped to OFOs (job titles are very different in different organisations). The system works on numbers reflected as scarce in each SETA: if below a certain number, it is not reflected on SETA lists. Even if on SETA lists as a small number, when aggregated the green skill may not make the National List, often also as a result of diverse nomenclatures for occupations.

Important to this thesis is that there is an emerging awareness of green occupations in SETA Sector Skills Plans which reflect the identified scarce skills in a sector, as reflected in Table 6.4. below (based on my analysis of the SSPs referred to above). Table 6.4 shows the occupations identified as scarce skills in the **2010-2011 SSPs (represented by a *)** and in **2013-2014 SSPs (represented by /)**. The table thus also helps to illustrate that there is a growing emergence of green occupations being prioritised within sectors. The data also shows the cross-sectoral nature of these occupations, and re-emphasises the importance of clear occupational descriptors for coherent national level skills planning and provisioning.

Table 6.4: Occupations identified as scarce per SETA (based on analysis of SSPs for each SETA in 2010/2011 and 2013/2014)



Note: * reflects occupations listed as scarce within 2010-2011 Sector Skills Plans within SETAs and / reflects 2013/2014.

The data above shows that in 2010/2011 41 occupations were identified as being scarce across the five SETAs SSPs investigated (16 for Energy and Water SETA; 4 for Local government SETA; 7 for CATHSSETA; 4 for Mining SETA; 10 for Agricultural SETA. In 2012/2013 69 environmental occupations were identified as being scarce across the five SETAs SSPs investigated (4 for Energy and Water SETA; 8 for Local government SETA; 5 for CATHSSETA; 10 for Mining SETA; 6 for Agricultural SETA.

This data reflects a significant increase (approximately 70%) in the number of green occupations that are being surfaced through the sector skills processes. This reflects the need for a significant education and training response to support and develop these scarce skills. A large majority of these are within the energy related sector but remain at high skill levels. This reflects that SETAs will continue to support high skilled training.

As indicated above, a Labour Market Information system exists which appears to be becoming more responsive to green skills. This is, however, based on inadequate current mechanisms for identification and structuring of green skills intelligence (e.g. the American Green OFO system, and lack of adequate value chain analysis of green skills and occupations per sector). There appears to be an urgent need for a more rigorous approach to the identification, analysis and anticipation of demand for green job skills at sectoral level, and synthesis of this information across sectors according to recognised occupational categories and descriptors, as also identified in the Green Fund proposal for system capacity building for green skills development (NESSPF, 2014). Recommendations related to this finding are made in Chapter 9.

6.9 Methodological challenges in working with skills systems

The challenges illustrated by the analysis and discussion in this chapter are synonymous with Breir (2009) who outlined that in attempting to define skills shortages it is important to determine occupational definitions. Breir (*ibid.*), drawing from occupational cases in research from other sectors, claimed to have struggled to clarify levels in occupational hierarchy with the wide divergence of titles and descriptions, areas of specialisation, divergent job demands, and the variety of economic sectors in which they play a role. Methods and means to illustrate the complex interaction between the various occupations in different sectors remains an important criterion (*ibid.*).

6.9.1 Reliability of official statistics

Compounding the above are large fluctuations in annual figures for labour force data which is widely regarded as unreliable (Kraak, 2009). Occupational data is often supported and strengthened with data from professional councils (as seen in two case chapters). For example, Todes (2009), in trying to develop illustrative picture of occupational data for planners, was able to construct his 'picture' from the South African Council of Planners, the South African Planning Institute, the Association of Consulting Town and Regional Planners and a survey of planners in KwaZulu-Natal, as well as the SAQA graduate database data.

In the absence of reliable national statistics on the environmental sector employment and skills demands, the ESSP research (South Africa. DEA, 2010a) information on employment and skills demands in the sector was constructed from a variety of sources including studies of the size and shape of the Environmental Goods and Services Sector, PERSAL (state employment system data capturing data on environmental occupations and vacancies in key occupations), annual reports and annual training reports to SETAs of parastatals who are a key employer in the sector, SMME employment data, and local municipality data on skills required for levels of environmental management functions as well as corporate employment data related to sustainability reporting and environmental management functions (South Africa. DEA, 2010a). Only through careful triangulation of this composite mix of data sources was it possible to develop a fairly crude perspective on green skills demand and learning pathways in the environmental sector (H. Lotz-Sisitka, February 15, 2012, personal communication).

This illustrates that there is no one source of official data and even with the availability of multiple sources of data "it is very difficult to be categorical in the absence of clearly defined professional or occupational boundaries" (H. Lotz-Sisitka, February 15, 2012, personal communication), and associated official sources of data capturing in the national systems of labour market analysis, monitoring and reporting. As shown above, this requires a systemic approach to green skills development and planning. Recommendations to this effect are made in Chapter 9.

An additional niche level systemic element influencing green skills learning pathways is the efficacy of career guidance and development systems, which I discuss next.

6.10 Career development systems: Enabler for seamless pathways

The OECD (2000) has identified career guidance as a key feature of effective transition systems and thus learning pathways. Career guidance can be defined as "services intended to assist

individuals, of any age and at any point throughout their lives, to make educational, training and occupational choices and to manage their careers” (OECD, 2004, p. 19).

The above documents raise the importance of career guidance as an institutional factor impacting on the character, quality and effectiveness of learning pathways. Effective transition systems have well organised pathways that connect initial education with work and further study and widespread opportunities to combine workplace experience with education. Thus, international best practice frameworks advance the importance of good information and guidance and tightly knit safety nets for those at risk (OECD, 2000; OECD, 2004).

In this section I will first explore general career guidance in South Africa before considering environmental career guidance within school-based as well as higher education institutions as it relates to green skills learning pathways. For data I have drawn from a range of career resources and my involvement in two green career research projects, namely the SANBI/GreenMatter project and the WWF study which I undertook with sector partners during the time of this study.

Provision of professional career guidance services remains a central tenant of the National Qualifications Framework in South Africa. Prior to the new NQF Act promulgated in 2008, responsibility for career guidance was shared between the Departments of Education and Labour (Crossland, 2006). Currently the National Skills Development Strategy III (South Africa. DHET, 2011c, p. 5) provides a clear mandate for career guidance as it aims to “encourage the linking of skills development to career paths, career development and promoting sustainable employment and in work progression”. There is a general perception that career guidance has been a neglected domain in South Africa (SAQA, 2008). In recent years more focused attention has been devoted to this important activity. A key issue has been that good quality career information is not uniformly and freely available to the general public. SAQA (2008) reports that the ‘key voids’ in information and career guidance provision are:

... national, independent, good-quality, publicly available information; no national strategic policy leadership in the field; no models for systemic Careers Guidance delivery; paltry funding to outreach organisations; and no public recognition that support and accessibility are intertwined. (p.25)

The above reality led to the establishment of the national Ministerial flagship project on career advisory services in July 2010. Funded through the National Skills Fund, the project saw the Department of Higher Education and the South African Qualifications Authority (SAQA) play a leading role in developing a broad-based career programme that could respond to vastly different needs across the country. Some key mechanisms (apart from general advocacy) to reach people

included a telephone, email and SMS helpline (this service enables people to send an email, sms to a freecall number and they are called back free of charge by a career counsellor); strengthening the network of career advice access points in the country (walk-in services in youth centres and 125 established walk-in centres of the Department of Labour); and a national career advice portal which is working on establishing learning pathways of 500 occupations.

The need for co-ordinated action was emphasised and October 2012 saw the emergence of the Framework for Cooperation in the provision of Career Development (encompassing information, advice, guidance) in South Africa (South Africa. DHET & SAQA, 2012). This framework saw the establishment of a common vision, guiding principles and a concerted attempt to make more efficient use of resources to forge partnerships between providers of career guidance. The intention is that this will result in a National Career Development Forum to be established by DHET and provincial Career Development fora, a process that is already underway.

6.10.1 Reviewing career development of environmental careers

This section considers environmental career development in two key areas – school based and university related. There is little information and data on career information in work progression, a gap that this study aims to fill in the context of the two occupational trajectories reported on in Chapters 7 and 8, potentially then also providing a methodology or way of beginning to review other environmental occupations for gaining deeper insight into how the occupations are structured and currently and potentially constructed, which will provide useful career orientation resources, especially for career information in work progression contexts.

6.10.2 Insights from assessment of school based career programme

The insights discussed in this section have been drawn from two research projects I was involved in and an assessment of general environmental career guidance resources as reflected in Chapter 5.

Mainstream career guidance resources tend to include mainly basic and common environmental careers e.g. an examination of science and technology careers by the Sci-Bono Science, a technology education centre in Johannesburg, revealed no major environmental careers integrated into their career resources (GreenMatter, 2012). The Department of Education endorsed the PACE⁸ career package produced by a private company, had a relatively extensive range of all careers; however, they were all high skilled, scientific and tended to imply the need for

⁸ PACE was founded in 1991 and provides accredited career guidance training for career practitioners and offers a wide range of career related products and services.

a BSc degree. Table 6.5 below, illustrates a review of six major career resources utilised in South Africa. The table reflects the occupations being featured, and what profile of the sector is developed for potential entrants. The data highlights that the careers featured are primarily high skilled scientific careers. They illustrate to learners that the broader scope of careers reside within a science related pathway. There are no intermediate level (artisan careers or technical careers) featured with the exception of the Environmental Technician. Furthermore, no social science or community conservation careers were highlighted, areas of work that encompass the social-ecological dynamics of environmental occupations such as social ecology or community-based natural resource management or community-conservation are not featured. This reflects systemic patterns and absences identified in other niche level systemic elements above.

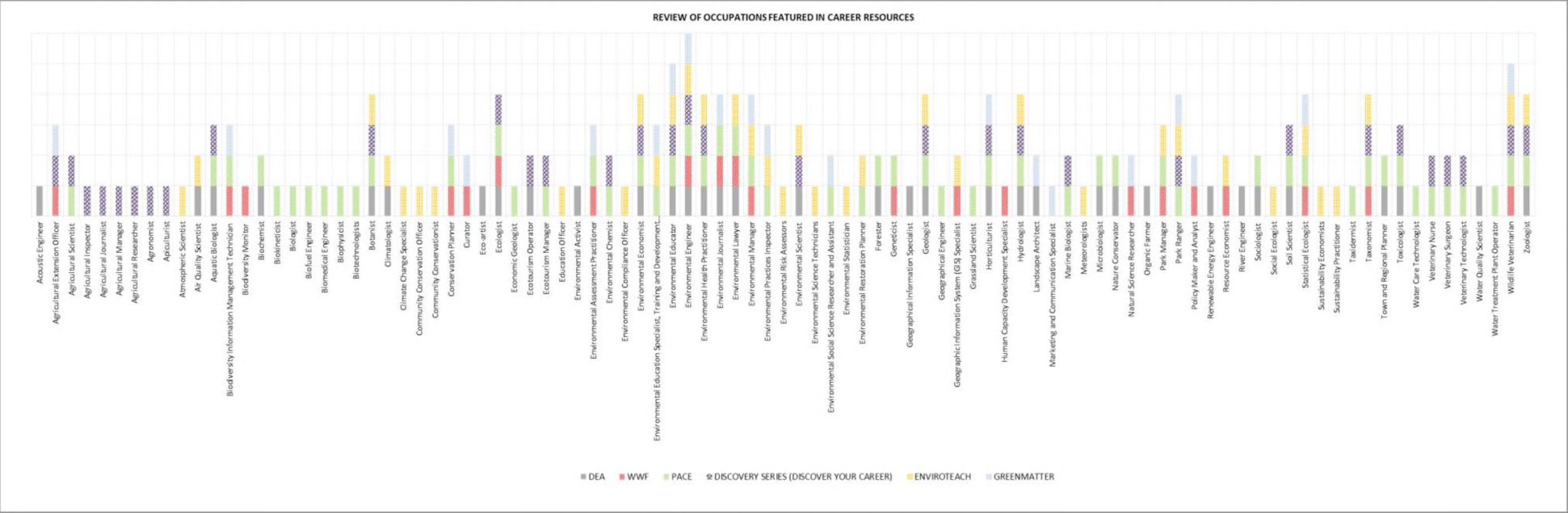
Currently available resources on environmental careers have been developed largely by environmental sector partners e.g. DEA careers booklet; *Enviroteach* magazines, and Mpumalanga Parks booklets. These rely heavily on the capacity of these partners to reach schools. They are often distributed during teacher workshops. A key challenge in the distribution of the resources was locating an appropriate teacher for the resources (Rosenberg, Raven, Nsubungu, Mosidi, Ramsarup, & Burt, 2009; Togo, Ramsarup & Malema, 2012). Interview data (Rosenberg, 2013, October 4, personal communication; FN 3); showed that often career guidance is regarded as the responsibility of the Life Orientation teacher but environmental career resources were being distributed to Science and Geography teachers in environmental workshops.

Rosenberg et al. (2009) raised the challenge that due to its 'newness' teachers and department officials have very limited knowledge of the current scope of environmental careers. Thus they receive resources from environmental agencies but are often unable to mediate them appropriately. It has also been found by these career orientation studies that knowledge and awareness of environmental careers in the environmental field is one the most significant factors limiting student choice (ibid.). This affects not only students in high schools but also students in universities as shown in the recent study by Dotwana (2015) whose research shows that honours level Botany and Zoology postgraduate scholars had little information on biodiversity careers or scarcity in the sector, affecting their decisions to continue into Masters level studies or not.

The 'newness' aspect is important to consider more carefully as many entrants into the environmental sector will be first generation entrants; they have little social capital on these careers and the type of work people do. In black households especially, there may not be many social network examples of people involved in these careers beyond conservation jobs like park

rangers. This highlights a need for more job shadow programmes and coherent career guidance at all levels of the system, particularly if the sector is to address its transformation imperatives, especially also at professional employment levels (FN13; FN15), but also to create more equitable forms of access and entry to the green economy as proposed by Death (2014).

Table 6.5: Review of Career Resources produced by six environmental organisations showing types of occupations represented



6.10.3 Insights from assessment of university based career programmes

Togo et al. (2012) found that career guidance initiatives are focused on school-going youth; many higher education students lack information about biodiversity careers and are unable to map suitable study and career pathways for themselves. Eksteen, L. November 2013, (personal communication) supported these findings and further highlighted that limited information for study and career planning among students may be a factor in graduate unemployment. The discussion below with the co-ordinator of the WWF university careers programme highlights some of these issues:

Students particularly struggled to see entry routes into the sector. Particularly those with first degrees. As a result, they often take jobs according to opportunity rather than preference. Most people's careers paths are not strategically mapped. Some students try to 'tailor make' their degrees according to what the sector needs, in their postgrad year they are not sure which specialism to select or whether it is useful to specialise. They are advised by lecturers but it would be nice if they can hear this from sector experts. (Eksteen, L. November 2013, personal communication)

The Togo et al. (2012) research found university career centres lacked resources and counselling staff with expertise to advise university students on environmental careers. In this study we sent interns into five urban university career centres with questions on how to become an Environmental Economist, Environmental Engineer, or Biodiversity Planner. It was alarming to see that none of the five university career centres were able to provide coherent career information or resources on the named careers. The interns were advised to study for a generic BSc and then specialise and were given no clear guidance on options. Two universities referred interns to faculties to gather career information.

Dotwana's (2015) study involving black women honours graduates in Eastern Cape universities, confirmed that there was little understanding of biodiversity careers or why these might be valuable amongst black women graduates at honours level, a factor also impeding their choices to continue to master's level studies in this field / sector.

McKrill's (2015) study showed that knowledgeable lecturers who were concerned with student's well-being and career prospects were important for guiding university students into scarce skill occupations and they played a significant role in orienting students to the profession. However, this relies on the 'good will' of a good lecturer, and it cannot be assumed that all lecturers are willing or able to play a strong career guidance / mentoring role, hence there is a need for more systemic interventions for career guidance. This could also exacerbate inequality as not all

universities or lecturers would do this equally and hence perpetuate unequal access to information and opportunity – hence the need for an open access national source of career information that gives clear environmental information.

The insights highlighted here, relate significantly to how pathways signal learners, which as discussed in section 4.3. is an important element of pathway construction. This section has also raised the need for continued focus on availability of career information across the whole pipeline. It also raised evidence on the absence of information for students seeking specialisation and guidance towards end of degree, as they seek access to specialisms.

Further recommendations related to this niche level systemic element will be made in Chapter 9. The next section looks at consolidating some of the surfacing patterns of emergence evident across this chapter in relation to the transitioning framework of the study.

6.11 Reshaping supply systems for Green Skills Provisioning to support environmental learning pathways

Across this chapter I have presented data to illustrate some of the **patterns of emergence** that are visible in the context of key niche systems level elements and related interventions and dynamics. As indicated above, these are selected elements of mainly the supply systems supporting Green Skills learning pathways construction and development. As shown across the niche level system elements discussed above, these are not static, but are emerging in response to the wider emergence of a green economy in South Africa, and also in response to increased concern about the social-ecological condition. Understanding these as dynamic and emergent niche level system elements with emergent properties within a wider laminated system, can potentially facilitate improved and more proactive approaches to green skills planning and development (see recommendations in Chapter 8).

Figure 6.9 below captures some of the ***patterns of emergence*** as observed in the study of these niche level system elements in relation to the laminated system used in the study.

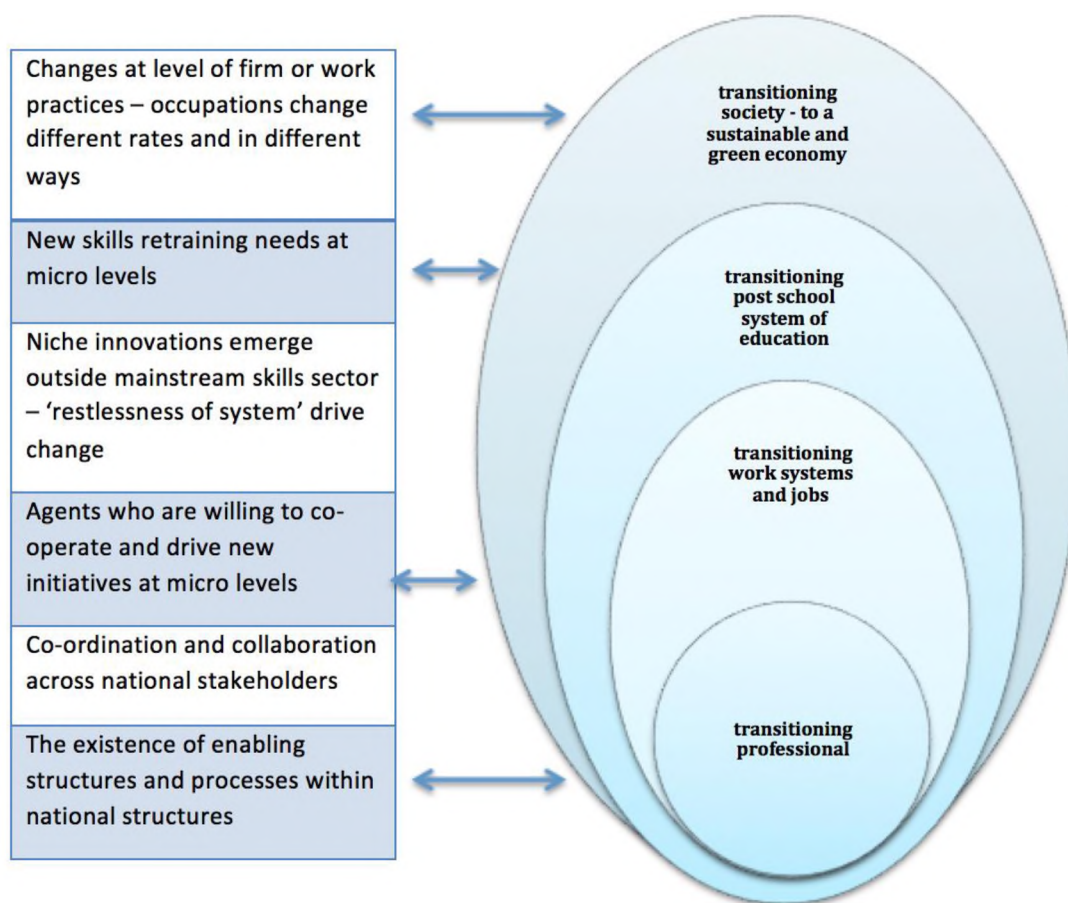


Figure 6.9: Patterns of emergence observed in transitional responses to green skills

6.11.1 Understanding policy coherence: Linking skills development and environmental policy

Coherence between skills development policies and environmental policy is fundamental in managing the transition to a green economy. In a study on the ‘green’ skills in South Africa’s economy, the International Labour Organisation (ILO) noted that “new skills and retraining needs for the greening sector should filter successfully through the ‘demand and supply’ process” (ILO, 2010, p. 19). Whilst there is a skills development focus and a greening focus, there is little articulated alignment between the two (ibid.).

Following in-depth country studies in 2011, the ILO conducted a review to assess the policy coherence between environmental policy and skills development policies in 21 countries. The findings, as illustrated in Figure 6.10 below, extracted from the ILO report, illustrates how South Africa featured.

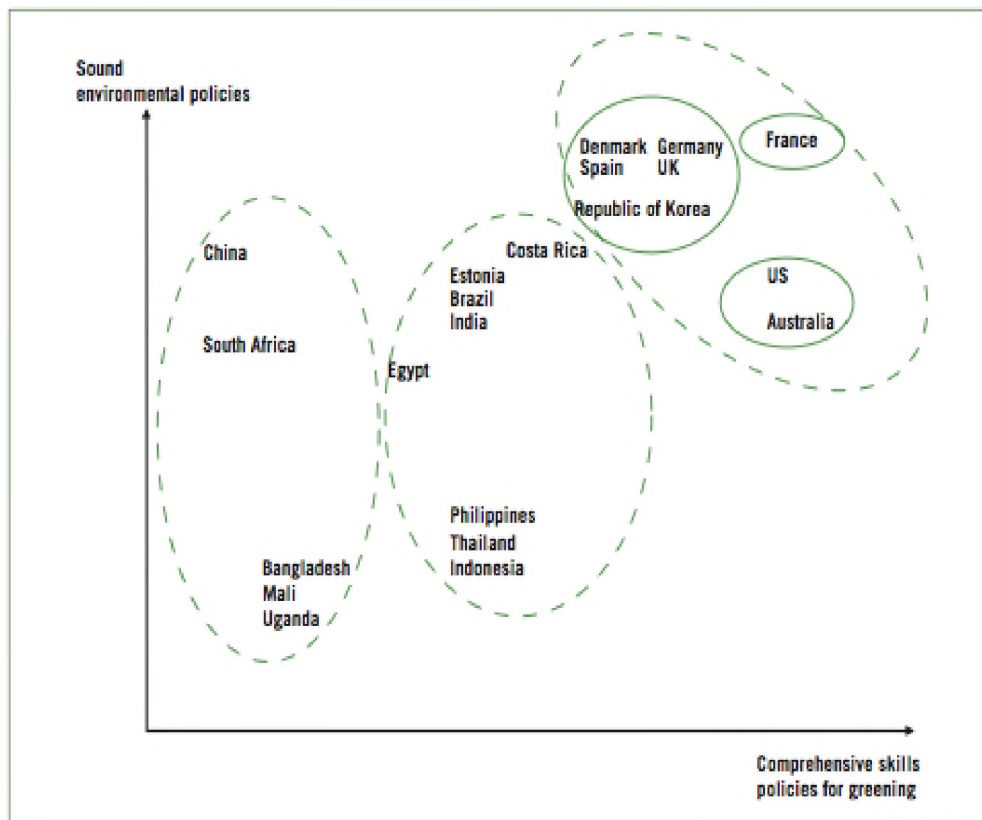


Figure 6.10: Coherence between skill and environmental policies (ILO, 2011a, p. 33)

Figure 6.10 illustrates that although South Africa has evolved in the environmental field at strategic levels, it is still experiencing implementation challenges from the perspective of comprehensive skills policies for greening i.e. there is a disjuncture between environmental policy making and green skills policy emergence, as also shown above. Central to this are the implementation mechanisms of green skills policy and training responses to improve skills for greening the greening the economy. As stated by the ILO, South Africa is “... yet to develop a comprehensive and coordinated approach” (ILO, 2011a, p. 40), a point that has been given further interpretive substance via the contents of this chapter.

In achieving greater coherence, what is required is not merely a focus on mechanisms to increase the ‘fit’ between the two systems, or to ‘facilitate transitions’, but a focus on strengthening the capacity of the education system in its own right (Allais, 2012).

6.11.2 Proactive skills planning from a base of better labour market information

This chapter has highlighted the absence of a clear understanding of the complex multifaceted nature of the environmental sector and the nature of the different jobs needed across the sector (now and in the future) coupled with an understanding of the system that produces and uses environmental professionals. The Environmental Sector Skills Plan for South Africa (South Africa.

DEA, 2010a) identified the need for better skills information; without this labour market information we cannot enable more skills planning, a point that has been expanded on in sections 6.7 and 6.8.

Based on the discussions in sections 6.7; 6.8. and 6.9. above, enhanced systemic capacity to provide for better labour market information will enable a better understanding of the skills mix (across levels of skills) needed in the sector. This recommendation is strongly supported by the Environmental Sector Skills Plan for South Africa (South Africa. DEA, 2010a). While I recognise this as being important, and based on the insights into the dynamism of the niche level elements that I have analysed above, I do not propose a technicist or positivist approach to such labour market intelligence development, but rather recommend a **reflexive and open systems approach** to such labour market analysis, via ongoing analysis of interacting niche level system elements within a laminated system (see also Chapter 9 for an expansion of this recommendation). It is well understood that the environmental skills needed today may not be the same as those needed in future given the rapidly changing social-ecological context. This may require innovation in labour market intelligence system designs that has a futures perspective (Cedefob, 2012).

6.11.3 Shaping a co-ordinated approach to greens skills

Chapter 2 outlined the numerous policy commitments to supporting the transition to green economy and the creation of green jobs. However, to date there is no coherent analysis and coordination of the skills needs. Current inadequacies in green skills learning pathway development and the inability of the education system to meet the needs have not been coherently discussed within education and training systems in South Africa. A co-ordinated response from DHET is still lacking.

Despite this extensive and complex green mandate, to date no adequate co-ordination mechanism has been established for the national planning and development of green skills in South Africa (Lotz-Sisitka et al., 2013; NESSPF, 2014). This has effects in terms of demand and supply analysis and provisioning, and is leading to substantive mismatches and a general situation of inadequate coherence as has been illustrated across this chapter.

Policy, programmes and training exist in pockets across the country but are not co-ordinated to work together. At all levels of government, non-profits, unions, and education centres are all working on their own green skill programmes leading to a proliferation of green jobs analyses and human capital development strategies, many of which are overlapping and/or 'double counting'.

These are yet to be coordinated to work together in a broader context within the wider economic development strategy and policy framework. Thus support for green skills seems to appear everywhere and is actually nowhere!

The figure below, used to frame the Green Fund proposal for national skills system development (NESSPF, 2014), which also draws on this PhD study, shows the start of establishing a more co-ordinated approach to green skills development in South Africa. This PhD work has thus far, fed into the emergence of this National Green Skills System building programme, where the insights from the data gathered in this study and especially aspects discussed within this chapter have fed into the programme conceptualisation. Figure 6.11 below illustrates how this collaboration is viewed within the new planned national project.

- Work Package 1 – is focused on system building, it supports the development of key education and training system structures to support green skills. It also aims to promote a more co-ordinated approach between national structures.
- Work Package 2 – is focused on building capacity of national educational structures through development of research and skills planning capacity.
- Work package 3 – is focused on understanding employer led demand for green skills and facilitating its coherent capturing within occupational structures like the OFO.
- Work package 4 – is focused on supporting clearer and more coherent career guidance and its transition within national career structures.

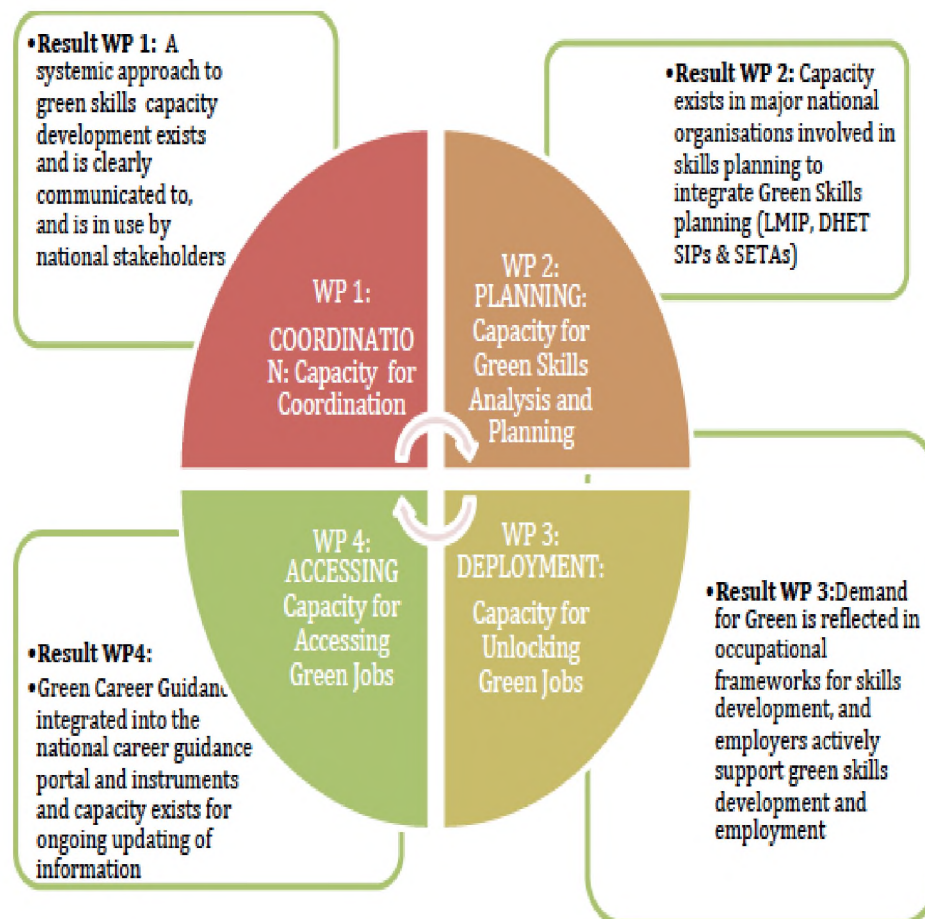


Figure 6.11: Collaboration within the new planned national project (NESSPF, 2014)

6.12 Conclusion

This chapter has explored priority niche elements. Regimes may be transformed by niche activities that focus on tensions that arise within regimes

This chapter raises and describes a number of key potential leverages for further change and development of the already dynamic emerging green skills system in South Africa e.g. occupational differentiation; better labour market information; improved skills planning; improved environmental career guidance; effective coherent provisioning that can all enable multiple entry multiple exit and support in an improved learning pathways model.

Lastly the chapter highlights the iterative relationship between niche activism and regime change, as it is proactive niches that begin to have impact on the regime and precipitate regime change by raising tensions that work against the lock-in mechanisms as explained within MLP introduction provided in Chapter 1 and Chapter 3. This chapter has outlined innovative emergences of green skills niche elements in provisioning of occupations; qualifications; career guidance and skills

sector information flow. The chapter thus provides a context for how these green skills emergences within the mainstream regime of the education and training system can be understood. It has further illustrated some of the key lock-ins in the different elements and thus provides the study with a leverage point for understanding transformative praxis possibilities (which are presented in Chapter 9).

CHAPTER 7: LEARNING PATHWAYS OF ENVIRONMENTAL ENGINEERING

*We must once more harness the expertise of our engineers and scientists –
and the ambition of our entrepreneurs – to embrace a green revolution
that will significantly change the way we all live and work.*

Death, 2014, p. 1

7.1 Introduction

As discussed earlier in this thesis, transition characterises our lives in this rapidly changing world with environmental issues and risks becoming increasingly severe. Within these realities, Chapter 3 outlined how the South African Education and Training system (itself in a transformational process state) has had to grapple with responding meaningfully to this new emerging environmental mandate. Chapter 6 outlined further the lack of systemic attention to environmental issues and also raised the issue of the slow defining of environmental training and occupations within the education and training system. The international call for a transition to Green Economies and within South Africa, the Green Growth Path and Green Economy Accord, all reinforce an emerging imperative for green skilling both nationally and globally (as discussed in Chapter 3).

Within this emerging scenario, environmental engineers have suddenly emerged as an absolute scarce skill in South Africa (South Africa. DEA, 2010a; South Africa. DHET SIPS, 2013b). Until 2011 this occupation did not exist as an independent occupation with South African occupational frameworks. Its recent emergence has raised both field based and systemic questions as reflected in this chapter. This chapter tries to build an understanding of the learning pathways of environmental engineers. By illustrating the 'typical' available institutional pathways and examples of pathways of practitioners, the chapter tries to understand systemic factors enabling and constraining the learning pathway of environmental engineers.

The data presented in this chapter has been drawn from career stories as well as a broader systems analysis for this occupation as elaborated in Chapter 5. The chapter presents a brief context of engineering in South Africa and describes how environmental engineering as an identified scarce skill is represented within the changing education and training system. The chapter then describes the key supply side platforms (qualifications and occupational framing) to illustrate the institutional and structural contexts that constitute and enable the institutional pathways for environmental engineers. The chapter then moves on to introduce career stories of

environmental engineers to help explain real navigations and stories of agents currently crafting a job that technically did not exist. Through these ‘assemblages of practice’ (Fenwick, 2013, p. 264), intermingled with institutional and structural realities, the chapter tries to raise occupational and systemic insights and thus illustrate the nature of the ‘REAL’ environmental engineering learning pathway as understood within a critical realist ontology. Figure 7.1 below provides an orientation to the different levels of elements studied to make sense of the learning pathway of environmental engineers. This emphasises the multi-layered, *relational and multifaceted nature of the environmental engineer’s learning pathway uncovered in this study*. The ‘multi-layered’ analysis of the career stories is extended by *system analysis* (e.g. analysis of the provisioning system of engineering qualifications; operations and approaches of the professional associations).

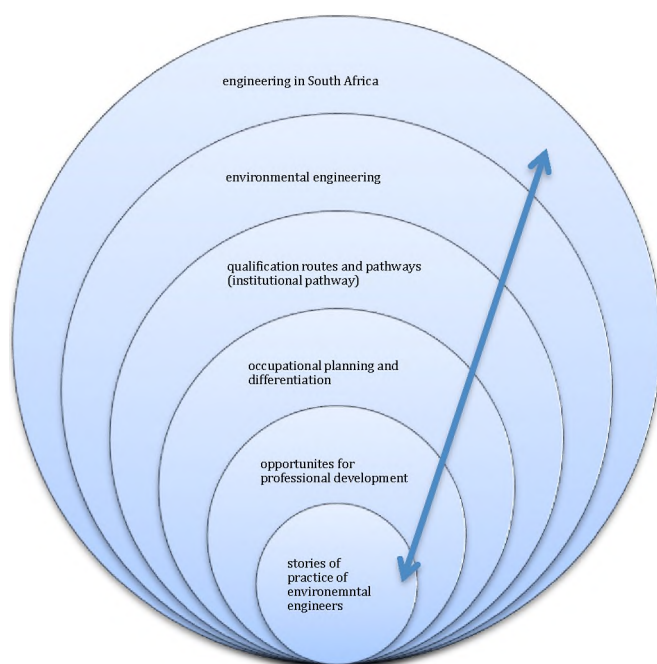


Figure 7.1: Elements depicting nature of learning pathway for environmental engineers investigated in this chapter

7.2 Understanding the context of engineering in South Africa

7.2.1 Regulation of engineering in South Africa

The Engineering Council of South Africa (ECSA) is a statutory body; it was established in terms of the Engineering Profession Act, Act No. 46 of 2000. ECSA’s mandate is the protection of the health, safety, environmental and all other interests of the public in relation to the activities of the Engineering Profession (Engineering Council of South Africa [ECSA], 2013; In03). ECSA is made up of 50 council members who are selected to provide a broad representation of all engineering

disciplines. Other members are drawn from the academic fraternity, government spheres, industry and the public.

Engineering disciplines recognised and catered for within ECSA are Agricultural, Chemical, Civil, Electrical, Industrial, Mechanical, Metallurgical, Mining and more recently Aeronautical was given status as an independent discipline (ECSA, 2004a, p. 7). Each discipline is coordinated by a voluntary association e.g. SAICE is the South African Institute for Civil Engineers with approximately 10 000 members. Cyril Gamede who was the former President of ECSA, illustrated the relationship between ECSA and voluntary associations as follows:

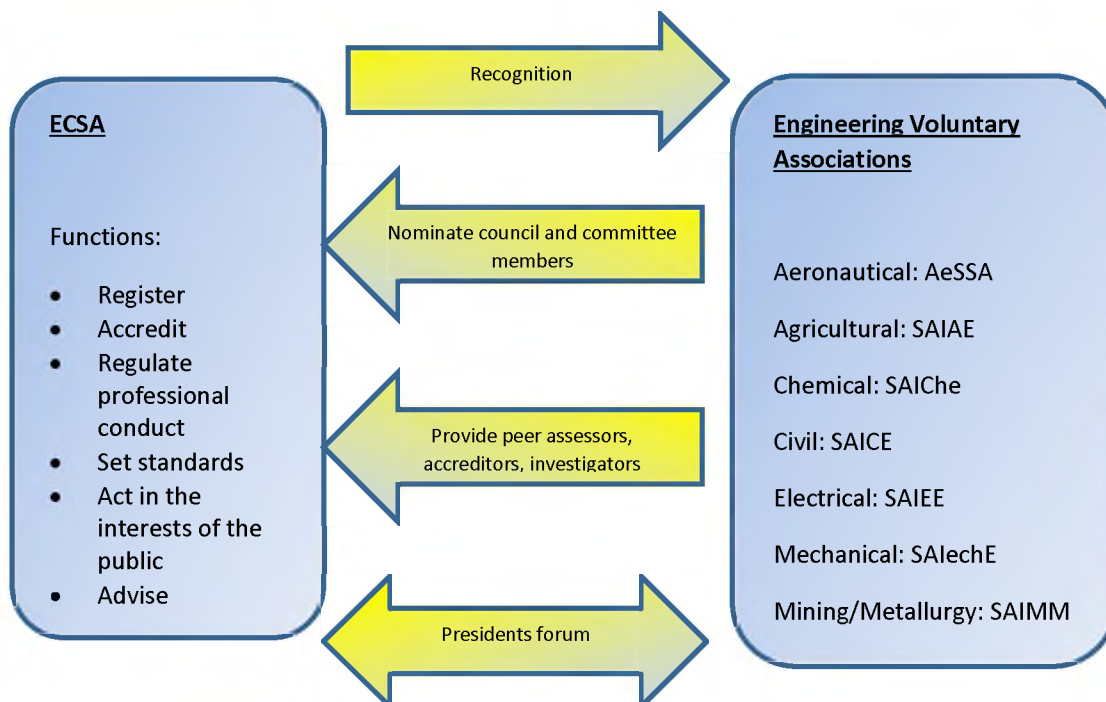


Figure 7.2: Relationship between ECSA and voluntary associations in engineering (Redrawn from Gamede, 2012)

ECSA operates an accreditation system for the various undergraduate qualifications. South Africa is signatory to three international agreements that enable the 'recognition of standards and qualifications' (Du Toit & Roodt, 2009, p. 1) within engineering: the Washington Accord – concerned with the recognition of the equivalence of the Engineering Degree and is applicable only to Candidate Engineer or Professional Engineer registration; the Sydney Accord recognises the equivalence of the Engineering Technologist; while the Dublin Accord provides recognition of the equivalence for the Engineering Technician (Du Toit & Roodt, 2009, p. 24). These are essentially part of a quality assurance process which enables South Africa's engineering graduates to be associated with the world's best practice allowing for transboundary mobility and marketability. Du Toit & Roodt (2009) acknowledged the high quality of South African engineering

qualifications and the demand for South African engineering graduates internationally.

7.2.2 Profiling the demand for engineers in South Africa

Data from the Human Sciences Research Council (2009) reflects employment of engineering professionals as follows: around 124 567 people were employed; of this almost a third (39 686) were employed as engineers and technologists and more than two-thirds (84 881) as technicians.

Despite widespread attention on changing the demographics of the engineering workforce, challenges remain. Within the engineering cohort, women account for 3% of the total and Blacks 12% (HSRC, 2009). Registration of professionals (data available on the ECSA website) further illustrates this employment demographic: in 2008, 1 256 whites were registered and 1 321 blacks (Asians, blacks, Coloureds).

Various sources have noted the shortage of engineers in South Africa (HSRC, 2009; Case, 2006). Lawless & Kirsten (2008) reported that AsgiSA's (Accelerated and Shared Growth Initiative for South Africa – which was a growth and development plan) objectives were to increase the number of engineering professionals by increasing graduates and improving throughput and efficiency of the current engineering education and training system. Government allocated R48 million in 2006 and an additional R439 million (\$ 37 894 870,71) for the period 2007-2009. Four large urban universities received targeted funding: these were the University of KwaZulu-Natal; University of Pretoria; University of Stellenbosch; University of Witwatersrand. The aim was to increase graduate outputs and address the shortfall of engineers in South Africa.

The dire shortage of engineers is illustrated in these international comparisons: South Africa has 473 engineers per million citizens while Japan has 3 306, the UK has 3 220 per million, the USA 2 570 per million. When compared to other upper-middle-income countries, South African figures are still far below: in Chile there are 1 460 engineers per million citizens, and in Malaysia there are 1 843 engineers per million citizens) (HSRC, 2009; Case, 2006). These statistics give a sense of the severity of the shortage that South Africa is facing. The current situation is relatively similar to this data. In 2014, Infrastructure News reported in an article, "South Africa is severely under-engineered ... South Africa only has a total of 15 000 engineers and has one engineer that services approximately 2 666 people whereas internationally one engineer services 40 people". Table 7.1 that follows also reflects the shortages within engineering as reported within the Strategic Infrastructure Programme (SIPS).

Case (2006) and McKechnie and Bridgens (2008) noted that the skills shortages are being experienced across the engineering workforce (comprised of engineers, technologists, technicians, and artisans). Drawing on JIPSA (Joint Initiative on Priority Skills Acquisition) targets, the sector has set out a skills pyramid, which reflects sector human resource needs. The skills pyramid is as follows:

1 graduate engineer: 1 BTech: 4 technicians: 16 artisans

(as cited in Case, 2006, and McKechnie & Bridgens, 2008)

This skills pyramid serves as a sector illustration of resource needs. Insufficient artisans and technicians (as the country is currently producing lower amounts than required) mean that graduate engineers are doing tasks that could be done by technicians (Case, 2006; McKechnie & Bridgens, 2008). The ECSA 2010-2014 Strategic Plan reflects two strategic objectives linked to addressing demand:

- 1) determine engineering skills requirements for the country and provide direction and solutions to the pipeline for engineering skills development; and
- 2) ensure the marketing of the profession to educate and attract learners to build the future engineering skills pipeline.

Recent large scale infrastructure programmes linked to the 2010 FIFA World Cup soccer stadiums and construction of the Gautrain prompted extensive expansion of the engineering industry in South Africa (ibid.). The South African National Development Plan (South Africa, 2011a) stipulates that the country needs to produce 1 000 engineers a year and a total of 31 000 new engineers by 2030 to meet its development and growth target.

In 2012 the South African government adopted a Strategic National Infrastructure Plan, which is set to develop “enabling infrastructure that fosters economic growth”. Eighteen large-scale Strategic Infrastructure Programmes (SIPs) have been developed to support economic growth and service delivery in the poorest South African provinces (Presidential Infrastructure Co-ordinating Commission [PICC] report, 2012). The table below extracted (edited to reflect only engineering related occupations) from a SIPS May 2013 Scarce Skills Report, reflects the broad engineering needs in the short term to ensure delivery of the SIPS programme. It gives a good illustration of short term engineering demand in ONE government programme.

Table 7.1: Overview of SIPS Scarce Skills (Adapted from DHET, 2012)

Occupational Cluster	Critically scarce (50-100%)	Significantly scarce (20-50%)	Scarcity indicated (0-20%)
Management cluster	121905: Programme or Project Manager (~350)	214301: Environmental Engineer (~300)	
		134901: Environmental Manager (~150)	
		121908: Quality Systems Manager (~100)	
		214201: Civil Engineer (~1500)	
		215101: Electrical Engineer (~1100)	
Professionals and Associate Professionals		311301: Electrical Engineering Technician (~950)	314301: Forestry Technician (~150)
	214907: Materials Engineer (~450)	226302: Safety, Health, Environment and Quality Practitioner (~550)	
	121905: Programme or Project Manager (~350)	214401: Mechanical Engineer (~500)	
	311401: Electronic Engineering Technician (~300)	132301: Construction Project Manager / Site Manager (~450)	
	214908: Materials Engineering Technologist (~150)	311801: Draughtsperson (~350)	
	351301: Computer Network Technician (~150)	311501: Mechanical Engineering Technician (~350)	
		311601: Chemical Engineering Technician (~300)	

A further challenge compounding the demand situation is that, as reported by Case (2006), a sizable number of engineering professionals are no longer working in engineering. Many have moved into the business sector, finance and banking. Case (2006) further noted that management consultancies are particularly interested in hiring the top students in engineering classes.

7.2.3 Understanding the engineering skills pipeline

Developing an engineer (as depicted below) is an holistic process and the engineering sector has established various systems that support development at different stages. The graduate workplace training phase is known as the candidacy phase. “Structured training, coaching, mentorship, rotations and secondments are all elements which need to become part and parcel of planning workplace experiences for young graduates” (ECSA, 2011, p. 5).

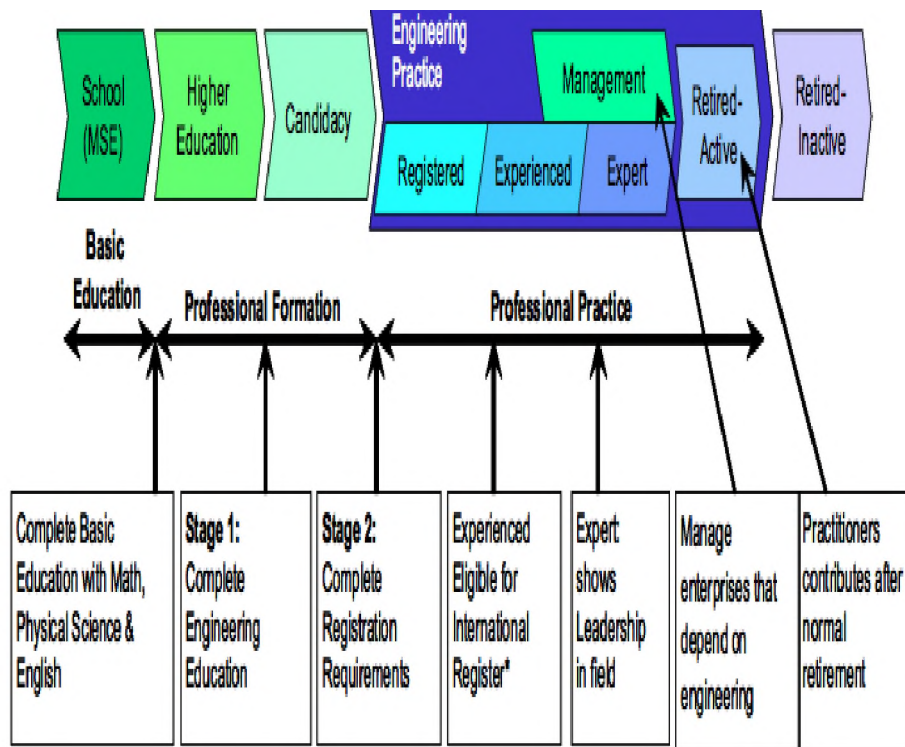


Figure 7.3: Pipeline for engineers (ECSA, 2012, p. 3)

Figure 7.3 above illustrates that supply of engineering is supported and co-ordinated through the regulation of a professional body beyond tertiary education. In November 2010 ECSA, supported by the voluntary associations launched the Engenius programme, aimed at “co-ordinating various initiatives on career guidance and recruitment for the engineering profession” (ECSA, 2010, p. 1). The Engenius programme aims at supporting school learners, teachers and parents. There are marketing campaigns, school expos, addresses by engineering professional as well as website support for Math and Science education activities for learners (ECSA, 2010).

ECSA and various voluntary associations support better higher education in the engineering sector, through a stringent minimum standards and accreditation programme. The sector has established the South African Society of Engineering Educators as a platform for best practice

exchange as well as inter-institutional collaboration. They have further established and support the South African Young Engineers Programme – which is both a financial aid project supported by various industry groups as well as a support programme for young students entering engineering within higher education.

In 2006 Case reported, while there has been significant growth in the numbers of graduates moving through technikons, there has been “only a marginal increase in the absolute number of engineers graduating from South African universities” (ibid.).

Using Department of Education figures, Du Toit and Roodt (2009) also reflected that overall throughput rates in Engineering averaged around 60% between 1996 and 2005 (ibid., p. 47). These points were further corroborated by Fischer (2011) in the Engineering Throughput report that was commissioned by ECSA, in which he reflected

Currently fewer than a third of all engineering students in Bachelors programmes graduate within the regulation time, and under two thirds graduate within six years. For African students, in particular, and for a range of reasons, throughput and graduation rates are even less satisfactory. Just under a third of African students graduate in five years, as opposed to 64% of white students. (ibid, p. 6)

The above discussion reflects that engineering throughput in South Africa remains a complex and multidimensional problem that is characterised by the interplay of curriculum, financial aid and staffing. Addressing these issues will remain, Fischer (2011) argued, a multi-actor (different levels of government, professional associations) and an institutional specific issue.

7.2.4 Continuous professional development within engineering

Engineers need to earn continuous professional development points to ensure their re-registration. All registered engineers are required to earn 25 points in a five-year cycle. ECSA (2013, p. 3) defined CPD as follows:

CPD can be defined as the systematic maintenance, improvement and broadening of knowledge and skills, and the development of personal qualities necessary for the execution of professional and technical duties throughout a person’s engineering career.

Points are earned in three categories (see below). Engineers are required to earn points in at least two categories each year and over the five-year cycle to earn points in all categories:

Category 1: Developmental activities: conferences; refresher courses, seminars

Category 2: Work-based activities: engineering work; mentoring of candidate practitioners

Category 3: Individual activities: membership of a recognised voluntary association;
other activities – lecturing; student supervision; publishing; self-study

The preceding discussion has provided an orientation to the engineering sector in South Africa within a focus on scope and regulation. The following section examines the emergence and shaping of the environmental engineering learning pathway.

7.3 Introduction to environmental engineering in South Africa

7.3.1 The emergence of environmental engineering

Internationally, environmental engineering is a recognised and established profession. In 2005 the American Academy of Environmental Engineers (AAEE) celebrated its 50th anniversary (American Academy of Environmental Engineers [AAEE], 2013).

The United Kingdom has the Society for Environmental Engineers. Both are professional associations. The Confederation of European Environmental Engineering Societies (CEEES, 2013) have 12 member states – Germany, Finland, Czech Republic, Austria, Netherlands, United Kingdom, Sweden, Portugal and Switzerland, all of which have country based environmental engineering associations. Environmental engineering is offered as an undergraduate degree across several European countries e.g. Germany, Italy (In 02). She explained further,

My experience, confirmed by a long discussion with prof. Rainer Stegmann yesterday from the Technical University of Harburg-Hamburg, who is one of the leading professors in Environmental Engineering in the world, is that this is not a hybrid degree and therefore subdued to a more traditional degree (like Civil or Chemical). It is an optimisation of various disciplines, which gives focus and direction to civil and industrial processes and projects (In02).

Within Australia, environmental engineering is a broad field and is described by Engineers Australia (2013) as follows:

Environmental Engineers are concerned with protecting the environment by assessing the impact a project has on the air, water, soil and noise levels in its vicinity. This is done by studying the project's design, construction and operation and minimising any adverse effects that it may have on the environment. Environmental Engineers are also involved in removing problems caused by past activity, such as cleaning contaminated industrial land so it can be used for housing. Environmental Engineers predict what problems may be caused by accidents, such as oil spills for example, and assess what may cause problems for the environment in the long term. They also plan and design equipment and processes for the treatment and safe disposal of waste material and direct the conservation and wise use of natural resources. They are involved in research and development of alternative energy sources, water reclamation, waste treatment, and recycling. (Dowling & Hadgraft, 2013, p. 10)

Reflecting the emergence of environmental engineering in Australia, “when environmental engineering started as a separate discipline of engineering, it was based on aspects of civil engineering, chemical engineering and environmental science. Later, when the Environmental College of Engineers Australia was formed, guidelines were developed to help define the discipline of environmental engineering’ (Lamborn, 2013, p. 3).

Within South Africa, a different scenario prevails, as a more integrative approach seems evident. The Engineering Professions Act (2000) states that ECSA will “create an awareness amongst registered persons of the importance to protect the environment against unsound engineering practices” illustrating that a policy framework does exist that requires all engineering disciplines to pay attention to environmental considerations.

As reported in Chapter 3, South Africa has been implementing a new environmental policy regime since 1998 when the National Environmental Management Act No. 107 of 1998 (South Africa, 1999) was proclaimed. This has implications for all sectors, and for environmental engineering. As noted by the Human Sciences Research Council of South Africa (HSRC), almost ten years after the proclamation of the National Environmental Management Act, “with forthcoming environmental legislation and new emphasis being placed on environmental protection in South Africa, increased levels of graduation in environmental engineering will be necessary” (HSRC, 2009, p. 52).

Two recent processes, the DEA national and provincial consultation during development of the ESSP (South Africa. DEA, 2010a) and the SIPS scarce skills analysis process (South Africa. DHET, 2013b), have identified environmental engineering as a scarce skill in South Africa. The *‘Meeting the Demand for SIP Scarce Skills’* document on skills required for implementing the Structural Infrastructure Programmes, recently produced by the Department of Higher Education and Training (DHET, 2013b), highlights that environmental engineers have been identified as being ‘significantly scarce’; this has necessitated the DHET to identify 300 environmental engineers to be trained in the short term to service the structural infrastructure programmes (DHET, 2013b). The DHET established an occupational task team for environmental engineering (I was a member of the task team) to discuss provisioning for the occupation (FN09); there was very little evidence of work, training and sectoral priority accorded to this occupation within the research process (FN09). This illustrates the rapidly emerging labour market demand for this relatively new skill within an unprepared education and training system as will be reflected below.

But within the engineering sector in South Africa, there is no visibility or formal recognition of environmental engineering as a specialised sub-discipline or field of practice. Christina Trois, Dean of Engineering at UKZN (In 02), explained that within South Africa, ECSA regards environmental engineering as a specialisation of civil engineering, so environmental engineering as a sub-discipline does not exist. She suggested that even after doing a masters in engineering a person “cannot go around saying they are a professional in environmental engineering” as it doesn’t exist as an independent discipline (ibid.). During workshop observations and interviews the opinions have consistently been that environmental engineering is simply a specialist form of civil engineering: “there’s no such thing as an environmental engineer” (In02). Apprehensions were also raised as to who would employ an environmental engineer (FN8; FN9; In05); as explained by one interviewee “They won’t be able to design fully, they won’t be able to construct fully so what exactly will they do?” (In 05). Another reflected that they will be bits of different engineers but will not be able to be independent engineers (In06). In her final reflection on the situation in South Africa in relation to the international situation, Trois (In02) stated,

My experience, confirmed by a long discussion with prof. Rainer Stegmann yesterday from the Technical University of Harburg-Hamburg, who is one of the leading professors in Environmental Engineering in the world, is that this is not a hybrid degree and therefore subdued to a more traditional degree (like Civil or Chemical). It is an optimisation of various disciplines, which gives focus and direction to civil and industrial processes and projects. The Environmental Engineer is indeed a process engineer, perhaps an hybrid between an industrial/chemical and civil engineer, who addresses projects in an holistic point of view and depending on the particular strengths available in the University where it is created and developed. (In 02)

7.3.2 Understanding current educational pathways

Understanding the types of qualifications available remains a critical issue in understanding the official pathways that are available for potential students.

7.3.2.1 Types of engineering qualifications

The Engineering Council of South Africa (ECSA) plays a leading role in accrediting and overseeing all engineering qualifications in South Africa. The Council is mandated by the Engineering Professions Act (See section 7.2.1) to conduct site visits whereby an accreditation committee evaluates engineering programmes to enable accreditation of these programmes. Only graduates from accredited programmes are recognised for registration as engineers. The table below provides an overview of the main programme types within engineering in South Africa.

Table 7.2: Qualification routes into differentiated occupational pathways

Programme type	Occupational pathway
Bachelor of Engineering	Candidate Engineer
Bachelor of Science (Eng)	Professional Engineer
Bachelor of Technology	Candidate Engineering Technologist Professional Engineering Technologist
National Diploma in Engineering	Candidate Engineering Technician Professional Engineering Technician

All engineering education programmes are governed by ten exit level outcomes. These outcomes need to be addressed within all engineering qualifications in South Africa. Each exit level outcome has a learning outcome and assessment criteria. Within the ten learning outcomes, environmental concerns are highlighted in the following: “Demonstrate critical awareness of the impact of engineering activity on the social, industrial and physical environment (exit level outcome 7)” (ECSA, 2004b, p. 7). Within the learning outcome on engineering design, environmental concerns are again recognised within the assessment criteria “Assesses impacts and benefits of the design: social, legal, health, safety, and environmental (AC6 Exit level outcome 3)” (ECSA, 2004b, p. 2).

ECSA has recently endorsed a whole range of new qualifications, which offer further options for entry into engineering:

- Higher Certificate in Engineering
- Advanced Certificate in Engineering
- Diploma in Engineering
- Advance Diploma in Engineering
- Bachelor of Engineering Technology

Each of the types of programme illustrated above lay the foundation for an institutional pathway into the engineering sector. I examined the engineering degrees currently accredited by ECSA (ECSA, 2012) and then constructed three tables – one for Bachelor of Engineering Programmes,

one for National Diplomas, one for Bachelor of Technology. The main source of data for the tables was ECSA programme accreditation lists. After compiling the tables (data sheet 1EE), I crosschecked the data on institution websites to see if there was any further institutional specialisation that was environmental. The data tables enabled me to review the scope of offerings, the differentiation of the currently available pathways and how environmental engineering featured within these. The discussion below outlines the findings and builds an empirical picture of the current institutional pathways (available through qualification routes) available for environmental engineering.

7.3.2.2 Undergraduate qualifications

7.3.2.2.1 BEng

The data on accredited qualifications that enable graduates entry through Bachelor of Engineering programmes reflected that at undergraduate levels, eight institutions offer BEng across the following disciplines: Civil, Electrical, Mechanical, Electromechanical, Electronic, Materials, Mechatronic, Aeronautical, Computer, Agricultural, Industrial, Mining, Metallurgical (Data Sheet 1 EE). The disciplines most extensively offered are Mechanical (offered by seven institutions), Computer, Civil, Electrical and Chemical (offered by six institutions). Only the University of the Witwatersrand reflected an undergraduate environmental engineering qualification as a Civil engineering specialisation – BSc Eng Civil - Environmental (ECSA, 2012).

Despite extensive differentiation across some disciplines environmental engineering was only visible at the University of the Witwatersrand. However, follow-up with the university revealed that the degree was discontinued for reasons outlined below. Alysson Lawless (Technical Advisor to the SIPs) reported (In05) that the university had run the programme for six years but it has subsequently been dropped as it attracted only six or seven students a year making it economically unviable. Feedback from the university outlined the following: due to the poor attraction of the course,

... the university would not commit to fund environmental engineers to sustain the programme.

We held a workshop in 2006 and invited key individuals who worked in environmental engineering. At the end of the workshop, the recommendation from industry was to drop the programme. It was recommended that students who wish to be an environmental engineer, should do an undergraduate degree in civil engineering and a postgraduate degree in environmental engineering. (In 05)

Lawless reported that the university thought it was a good programme but it was “ahead of its time” (In 05).

7.3.1.2.2 Technical Route: Nat Dip Eng

The data on technical universities reflected that National Diplomas in Engineering are offered at ten technical universities across the following disciplines: Chemical, Civil, Electrical, Mechanical, Metallurgical, Industrial, Mining and Computer. Civil, Electrical and Mechanical are offered across all ten institutions. The data reflects extensive differentiation of electrical and mechanical engineering diplomas (Data Sheet 1 EE). There are no accredited National Diplomas (as at May 2013) with any form of environmental specialisation reflected.

7.3.2.2 Post Graduate Qualifications

7.3.2.2.1 Bachelor of Technology

This is the postgraduate qualification within technical universities. The data reflects that the following institutions have environmental specialisations within their BTECH options:

- Tshwane University of Technology has a BTech Civil specialisation in Environmental Engineering
- UNISA has a BTech Eng Chemical: Environmental and UNISA also has a BTech Eng Civil: Environmental
- University of Johannesburg has a BTech Civil: Environmental
- NMMU has a BTech ENG Civil Environmental.

(data drawn from ECSA, 2012 programme accreditation data)

7.3.2.2.2 Masters Degrees

ECSA does not provide accreditation for master's degrees so data on masters was not unavailable from ECSA. I thus compiled the data sheet from National Learner Resource Database (NLRD) data as well as institutional website data. I needed to crosscheck with institutional websites, as all specialisations are not always reflected on NLRD. The data, as summarised in data sheet Data Sheet 2, reflected that the following institutions offered masters in environmental engineering:

University of Witwatersrand and University of KwaZulu-Natal (UKZN) offer course work masters with a half dissertation. At UKZN the masters in Environmental Engineering is offered jointly between civil and chemical engineering. At Wits it is offered by civil engineering. Other universities offer full thesis research masters, e.g. Stellenbosch, University of Pretoria, University of Cape Town. Environmental Engineering specialisations are available in a range of qualifications but

specialisations reflect dominance in Water Care, Energy Studies and Environmental Geography (Data Sheet 2).

Interviews at two institutions (In 01; In02; In03) reflected that bursaries for master's students with environmental specialisations were definitely fewer when compared with mining and other chemical sectors. However, they both indicated an increasing interest in environmental engineering (ibid.), especially from people within small engineering consultancies (In 03).

The data thus indicates that environmental engineering qualifications emerge at postgraduate level and are not clearly integrated into other levels. A further important observation was that environmental engineering qualifications were extremely difficult to find. This is because they are recorded as specialisations of other forms of engineering (e.g. Civil), and as such they don't appear on National Learner Record Database or ECSA information sheets. Institutional websites offered a bit more information but it was necessary to look within specialisations in civil and chemical engineering.

7.3.3 OFO – The defining of the occupation

In attempting to understand how environmental engineering is represented within the occupational frameworks, I studied the South African Organising Framework for Occupations (see section 6.5.), version 9 in 2010 and version 13 in 2013. As discussed in Chapter 6, occupational framing is significant for orientating human resources planning and funding for skills development in the national South African skills system.

The representation of environmental engineering in the OFO version 9 reflected an occupation that was viewed as a specialisation; it was represented within Chemical Engineer (233101)⁹ as an alternative title – Environmental (Water, Air, Soil) Engineer as well as a specialisation within Civil Engineer (233102). Similar representations were noted with Chemical Engineering Technologist (233102) and Civil Engineering Technologist. However, no representation was noted within the technician occupations, again reinforcing the notion that at intermediate levels, environmental engineering as an occupation does not feature, as it is a specialisation.

The Version 13, 2013 OFO data reflects the emergence of environmental engineering as an independent occupation. It has been allocated an independent unit group, '2143 Environmental Engineers', which has two occupations thus far within the unit group – 214302 Environmental

⁹ Number is the allocated six digit OFO code

Engineer and 214302 Environmental Impact Restoration Analyst. The technologist and technician remain unchanged from 2009 version (refer to Chapter 6.5. for further explanation on the structure of OFO). Probing with skills officials and human resource development colleagues (In17; In05; FN9; FN11; FN12) ascribed the sudden inclusion of environmental engineering in the OFO, which was unknown to engineering officials (In05) to the porting of green occupations from ONET (American occupational framework). This mass porting of green occupations from ONET (see section 6.5) occurred at official skill levels but the engineering sector in South Africa was unaware and unsure how to categorise (still categorised as a specialisation within ECSA policy and framing (In05). This raises the discontinuity between sectoral framings and skills system framings for the occupation.

This discussion on occupational pathways framework of environmental engineering reflects a transitioning profession within a transitioning educational system. However, the pathway reflects discontinuities – the OFO, considering its purpose, should be a core tool in reflecting how human resource departments could plot career pathing of this occupation. It should also coherently represent the occupation so that the system is able to generate supply and demand information and so that it can serve as a core tool for workplace skills planning.

7.3.4 Continuous Professional Development (CPD)

I explored websites of both SAICE (2012) and ECSA to investigate ECSA accredited Continuous Professional Development options supporting environmental knowledge and competence. There were no environmentally related courses depicted as options for engineers (FN9). There are however options for individuals to do other courses and submit an application to ECSA for accreditation, as reflected in the career stories (see section 7.4. below). However, the challenge is that some organisations won't pay for these courses (EE1; EE3).

7.3.5 Career guidance and information

The Engenius programme is the flagship career programme of the engineering sector. It is a well designed comprehensive programme, including activities for learners, teachers' lesson plans and career information as briefly mentioned above (section 6.10). No information on environmental engineering was available on the Engenius website as well as in the careers flyer I studied (Engenius brochure, June 2012). The only reference to a possibility of environmental engineering as an option was found on a loose flyer that I found on the website. I have inserted the diagram

(see Figure 7.4) as it shows the scope of engineering and how the sector sees environmental engineering within its broader framework.

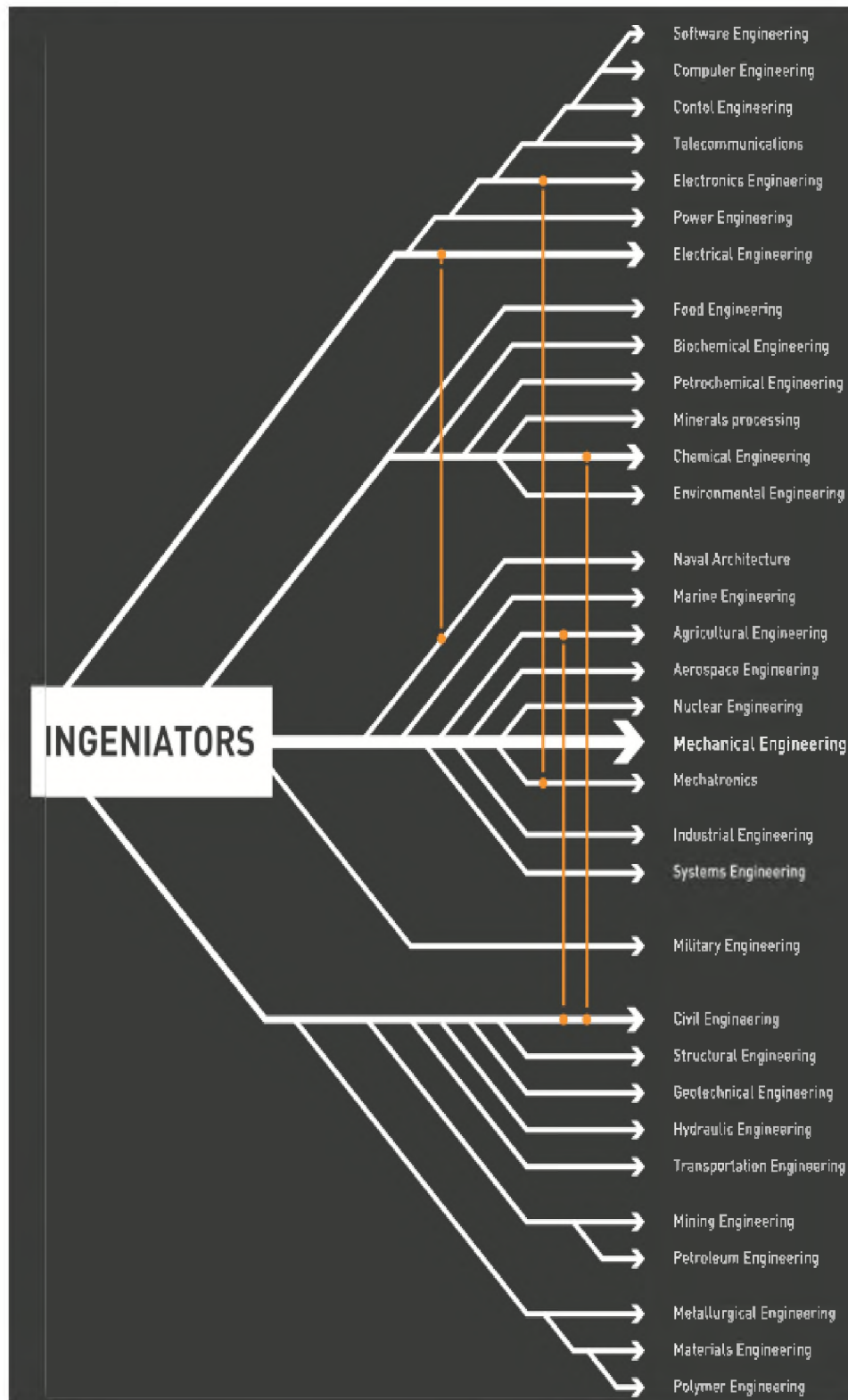


Figure 7.4: Scope of engineering as presented by Engineering Sector Career Programme
(Extracted from ECSA website, December, 2013)

The 2012 version of the PACE¹⁰ /GreenMatter career guide on 20 priority environmental careers in South Africa is a well-known careers document and it has since been developed into a mobile app which is actively promoted to learners (In19). It has also facilitated the introduction of these twenty environmental careers onto the *Gostudy website*¹¹ (managed by PACE, <http://www.pacecareers.com>) as well a career resource for universities by WWF-SA (2014). The 2012 PACE / GreenMatter career guide listed the environmental engineer¹².

Extracts from the career guide's introduction to the environmental engineering occupation reads:

Environmental engineering is the field of engineering concerned with local and worldwide environmental issues. Environmental engineers use the principles of Biology and Chemistry to provide practical solutions to problems related to the environment.

... Environmental engineers conduct hazardous-waste management studies, evaluate the significance of the hazard concerned, make recommendations on treatment and containment, and develop regulations to prevent mishaps. They design and operate processes to treat waste to a standard acceptable for discharge into rivers and dams or recycling, for example, wastewater treatment and waste solidification. They are also involved in the protection of wildlife. They may work with occupational health experts to ensure a hazard-free working environment.

... Engineers typically work outdoors some of the time, but also spend time indoors developing their strategies and communicating their plans.

(GreenMatter career guide, 2013, WWF career resource, 2014, emphasis my own)

The highlighted information gives an indication of the imprecise information presented in the career guide. When interviewed, the researcher who developed the guide insisted that the information was sourced from professionals and approved by professionals (FN3).

The pathway information given to students in the career guide is as follows:

Degree: Study BEng or BSc Eng Civil Engineering and combine or follow up with a long or short course in environmental studies.

Environmental Science or Environmental Health courses are offered at all universities.

Environmental engineers are part of the larger Civil Engineers occupational group.

Diploma: BTech Civil Engineering and Environmental courses are offered at all universities of technology.

(extracts from draft Career Guide, 2012, emphasis my own)

¹⁰ PACE is a nationally recognised career body. It holds the mandate for the national career services and PACE resources are endorsed by the Department of Basic Education. They run programmes at schools across the country.

¹¹ 'Gostudy' (<http://sa.gostudy.info>), linked to PACE, has been promoted as the most comprehensive career database, and is extensively used and supported by the Department of Basic Education.

¹² Note there has been no update to the information on this resource as at December 2015.

From the career pathway discussed above we can see that the information is incomplete and does not give students a clear indication of the qualification pathway. The section on career pathing is incomplete and on probing this, the PACE researcher who compiled the information (FN 3) claimed that the information was unavailable in any career system that PACE normally used so she was unable to give an indication of how to develop a career to become an environmental engineer (FN 3). A discussion with the project manager of the PACE programme reflected that environmental engineering was one of the careers for which the PACE research team was unable to plot a learning pathway as people needed:

... more than one basic area of expertise they needed to get under the belt then a postgraduate and then you still needed to add something like short courses, or work experience etc. etc. on top of that... The researchers indicated that it was very difficult to plot and is not the advice you can give to a matriculant. (In19)

7.3.6 Key insights on the institutional pathway for environmental engineering

There are a variety of Bachelor programmes in engineering: technical and technological and new accredited programmes also reflect further options for certificate engineers. This differentiation gives different access routes and opportunities for 'second-chance' pathways, which are critical in transforming educational access in South Africa as discussed in Chapter 3.

Representation of environmental engineering pathways, however, does not depict a sense of continuity across the available options. As stated by the Dean at UKZN "In South Africa today there is no such degree called environmental engineering. If someone needs to specialise in environmental engineering, he/she has to do either civil engineering as a basic degree and then either MSc either by research in the field of environmental engineering or coursework masters" (In02). The data generated for this study reflects that environmental engineering is essentially viewed as a specialisation of dominant engineering disciplines; as such available offerings reflect fairly specialised options. Within the sector, this is not viewed as an overt problem: as reflected in following interview (In 03) "the workplace specialises you then you can refine those skills by entering a masters. I think specialisation should happen in the workplace".

The very recent emergence of environmental engineering as an independent occupation on the OFO has not been significantly responded to by SETAs in their sector skills planning at the time of writing this study. This is understandable given that the description of environmental engineering only appeared in the OFO in 2013.

Although there has been recognition of environmental change issues and observations of legislative change, and despite the increasing awareness of environmental engineering as a 'scarce skill' in South Africa, as expressed in the DHET (2013b) Structural Infrastructure Programmes (SIPs) skills needs analysis, the data on institutional pathways discussed here shows very little evidence of constructive, systemic uptake of environmental engineering within engineering education and training systemic structures. The discussion has raised issues that require intervention within the systemic 'infrastructure' to adequately respond to this substantive scarce skill need.

7.4 Crafting the emergence of a Green Job within engineering: Transitioning experiences

7.4.1 Overview of this section

In this section I will outline the career stories of seven environmental engineering practitioners. Using Wheelahan's (2009) construct of pathways as educational and occupational progression, the career stories were constructed using in-depth semi-structured interviews. These were corroborated with CVs to deepen knowledge of career pathways. Appendix B reflects an extract from the story of EE2; it provides an indication to the reader of the type of data generated by the career stories.

The use of career stories gives preference to trigger events (Greenhaus & Callanan, 2006; Elder, 1994), which are used to build an evidence base that is characterised by transition processes and outcomes. It has been shown across the career stories that people, in detailing their career stories, give preference to trigger events, which they then use to tell their story (Elder, 1994). According to Raffe (2003), the career stories can therefore be described as depicting individuals' 'navigations of pathways'. I use Raffe's terms (career stories / navigation of pathways) in my discussion. The career stories detail transition experiences across a broad scope and range: from work to education, transitions within educational and training systems and transitions in occupational and work life (Sawchuk & Taylor, 2010). "Pathways are well travelled sequences of transitions shaped by cultural and structural forces" (Pallas, 2003, p. 168) thus surfacing and understanding learning and work transitions can provide significant lessons on the nature of the complex dynamic and social relations and institutional frameworks enabling and constraining environmental learning pathways. Field (2012) highlighted that stories will help with constructing meaning and authenticity from people's experiences of a rapidly changing modern world, and can therefore help develop a more nuanced idea of learning and educational processes.

The career stories remain individual experiences but as Eccelstone (2009) argued individualised

transition pathways tend to have collective consequences especially in relation to existing support systems in a transitioning society. Individualised transition pathways are also shaped by shared structural conditions (e.g. lack of options and/or emphasis on environmental engineering in the systems of supply and career orientation as outlined in section 6.10).

I made the decision to use career stories, fully cognisant of the critiques against using retrospective data and the limitations of how and what people relate of their stories (Fenwick, 2013). Career stories were necessary within this study to enable an understanding of how people crafted the emergence of a green job within engineering. To mitigate against the flattening of complexities in stories that Fenwick (2013) highlighted, I used a critical realist underlabouring to surface the mechanisms underpinning the experiences and events highlighted in the stories as described in section 5.3.

In the first layer I tried to understand the formal chronology of states and transitions in people's lives. I also considered the ways that they made sense of their learning to work transitions and thus created multiple layers of analysis using the career stories. In the first layer, using an Excel spreadsheet, I divided the discussion into key stages and transitions. People tell their stories very differently and this enabled me to organise the data but also to develop a framework for descriptive and analytical work related to the career stories. In the subsequent layers I used different analytical tools e.g. systems of influence as the second layer and job mobility as the third layer (see Table 5.5.), that explains analysis of career stories). This helped me to focus the study on transition processes instead of single events as I tried to uncover the relational and multifaceted nature of the real learning pathway and the embedded learning and work transitions.

The stories are drawn from a range of engineering consulting firms although private firm names are not revealed. An effort was made to seek individuals from a range of races and ages for the interviews as I wanted diverse stories (see section 5.4.2.). This was a challenge and I struggled to identify black professionals working as environmental engineers. Table 7.3. below outlines the race and gender dynamics of interviewees. It should be noted that significant progress towards transformation has been made in the broader engineering sector but this is not represented within the environmental specialisation. I made many attempts to contact companies in order to engage with black environmental engineers. I was unfortunately unsuccessful in finding a black South African graduate. EE9 listed below was from the Democratic Republic of Congo and only came into South Africa through a company he was already working for in the United Kingdom.

These career stories attempt to illustrate the learning and experiences across the life course and try to illuminate the biographical agency of people as they craft their “educational and occupational biography” (Heinz, 2002, p. 225). While the attempt to develop a number of career stories was an attempt to give a sense of the overall picture of practising environmental engineers in South Africa (see section 5.3. and 5.4.2. for sampling criteria), “the experience of transition is hardly universal” (Sawchuk & Taylor, 2010, p. 14).

7.4.2 Understanding transitions over the life course: Key educational transitions

The focus of analysis in each career story was educational progression into an environmental occupation. In the discussion below I outline experiences during key educational transitions identified within each story and across the stories. The evidence from career stories (drawn from interview data and CVs) is outlined and where necessary, I have tried to provide ‘thick descriptions’ (see Chapter 5.6.1. where this is discussed as a strategy to enhance validity in qualitative research) to support my discussions. These stories have tried to reflect both the processes and outcomes of transitions.

I start with brief maps of the life course learning pathways into environmental engineering of each of the nine respondents (see Table 7.3 below), and then discuss them collectively within the life course framework (in sections 7.4.3.; 7.4.4.; 7.4.5; 7.4.6. below). I will begin by briefly describing some of the experiences of the engineers in this study at each key life stage.

Table 7.3: Overview of respondents’ career stories: Key educational and work transitions

Interviewee Reference	Demographic	Story
EE1	White male	Loved geography at high school and believes that it influenced his decision to pursue his chosen career path. Did a diploma in civil engineering then a degree in BCom part time, a diploma in international project management and a MSc in Built Environmental Sciences. Currently working on PhD. Always had an interest in human impact on the environment. Worked abroad in Lesotho, Botswana and Nepal. In 2005 had an opportunity to get involved with the Green Building Council, which allowed an opportunity to influence many technical advisory teams across diverse sectors. The transition from the engineering sector to the environmental sector took seven years. Currently a sustainability consultant mainly focusing on Green Star Certification - energy optimisation.
EE2	White male	Went to a model C school (previously white public school).

Interviewee Reference	Demographic	Story
		Enjoyed the broad coverage of subject areas – geography stood out the most. During schooling years, there was no concept of environmental science. Went on field trip to offices that dealt with built environments and landscape architecture and decided that was what he wanted to do. Got a degree in landscape architecture from the University of Pretoria and a bursary from the Department of Water Affairs (DWA). Used short courses and work experience to develop his career. Started off as a technician at the DWA where he worked in a unit for ‘special tasks’. Worked closely with engineers at DWA and started to create a new awareness around the environment. Primary focus at DWA was rehabilitating and landscaping areas post DWA activities. Great team synergy at DWA allowed him to build on and use the knowledge and experience of the team. The work environment lent itself to mentorship. Designed a whole new process for planned projects at DWA with the focus on reducing environmental defects. Numerous success stories gave environmental work within the DWA a presence and helped him create a profile. Later became a consultant and took on a different range of work, spent six years on the Lesotho Highlands Water Project. Working on site daily was a totally different experience and hard work. It is important to have a broad base of work experience to gain skills. Identify opportunities and seize them.
EE3	White male	Grew up on a small homestead so he had early exposure to nature. When to Rand Afrikaans University and took zoology and botany as subjects. During his final year, got hooked on botany while on a botany tour of the Cape. Got his honours and masters in Botany. Got a job at the department of agriculture where he stayed for 12.5 years. He used one of the projects there for his PhD. Moved to Department of Development Aid as head of nature conservation, which was absorbed into Environmental Affairs. Worked on legislation and policy – the NEMA Biodiversity Act. Left government and joined an engineering firm as a private consultant.
EE4	Black male	Went to a public school where he took geography as a subject. Early interest in nature and the environment came from his father and grandfather. Grandfather was a mining engineer arranged for him to speak to engineers and environmentalists – this influenced his decision to pursue a career in environmental and geographical sciences with an engineering influence. Did a BSc (Chem Eng) at UCT as there were no undergrad options for environmental engineering. During his 4th year he attended Prof. Harro von Blotnitz course on environmental process engineering. This

Interviewee Reference	Demographic	Story
		introduced him to diverse career paths within engineering. Did his MSc in Environmental Engineering at UKZN – 50% dissertation and 50% coursework. This provided him with a broader environmental knowledge base. Decided that environmental chemistry was the field he wanted to get into. First job was working with waste at a large engineering company. Then moved to an environmental consulting company, which was later taken over by a large engineering firm, who then sold off the energy services unit. Always knew he wanted to be in the environmental sector.
EE5	Indian female	Had a natural interest in maths and science in school. No exposure to environmental sector provided by school. Obtained a degree in BEng Chem. A talk she attended during her 4 th year of study on environmental legislation excited her. She worked for the Department of Water Affairs, where she worked on a project dealing with acid mine drainage. This ignited her interest in the environment and doing something good for the planet. She then worked for Sasol for two years where she witnessed the complete disregard some engineers had for the environment in their planning and design. She then moved to an Engineering company carrying out environmental impact assessments and issuing environmental permits, mining applications, etc. After 10 years, she left to be an independent consultant.
EE6	Indian female	Attended a public school then went onto to obtain a BSc degree with honours in Medical Biochemistry and Genetics. She then did her MSc in Biotechnology and PhD in Civil and Environmental Engineering at the University of the Witwatersrand. Her PhD was in Organic Degradation and Bacterial Population. She worked at an engineering company as an associate director of waste management company. After numerous researcher positions, she finally ended up at an Engineering company specialising in waste as a process engineer/environmental scientist. She has since moved and is an Environmental/Waste Engineer at an international engineering company.
EE7	White Male	Did a BSc Civil at the University of Pretoria. Worked at large national engineering company as a Design Engineer. Left to join an environmental consultancy where he became an associate. Moved to an engineering company and is currently at a large engineering company as a environmental engineer and environmental auditor.
EE8	Black male	Works in large mining company – but schooling and undergraduate studies overseas. Not South African. Studied in UK and worked for an engineering company focused on

Interviewee Reference	Demographic	Story
		water issues in UK. Got involved in mining work and came to South Africa through a large international mining house. He currently works as an environmental engineer within a large mining company.
EE9	White male	Works in a large international engineering consultancy – but schooling and undergraduate degree overseas, done in Europe. He did an undergraduate degree in Environmental Engineering in Italy. He came to South Africa through his company to support environmental projects in his company. He also did a masters in South Africa in Environmental Engineering.

The data captured in the table above is discussed in more detail in the sections below (sections 7.4.3 - 7.4.8).

7.4.3 Understanding experiences of transitions within schooling

Due to educational policy in South Africa, all interviewees in this particular case example remained in school until grade twelve, reflecting a fairly normative and successful school to university transition (it should be noted that this is not the experience of a large proportion of the population however, as there is a high number of dropouts along the way, despite policy). The reflected dominance of the academic pathway is not uncommon in South Africa (within functioning schools as was reflected in the data for this study) and broadly meant that all interviewees followed an academic pathway within secondary school. Two essential factors emerging in the schooling transition experience for all of the interviewees in this case example were subject choices and career information.

In response to questions regarding reasons for career orientation, there was a clear sense among all respondents that “school did nothing to generate environmental interest” (EE5 and EE6). None of the interviewees reported that they had been part of any environmental activity at school. EE4 elaborated that there were ‘no environmental groups’ and also commented on school not having influenced her interest in an environmental career. A further interesting point about their reflections on their environmental experiences within schooling was that all reduced their responses to participation in clubs or “I was not really a terrible nature lover” (EE2) and “no real interest in greenie things – just wanted to be an engineer” (EE3). But it should also be remembered, as articulated by EE1 that “school is a distant memory”.

As can be expected, given the occupation under study, all interviewees conformed to the normative educational pathway (in relation to students entering a scientific career) and did mathematics and physical science. Some reflected a “natural interest in science and maths” (EE5).

An interesting observation amongst four of the nine respondents, was the influence of Geography. EE1, EE2, EE4 and EE6 all reflected that Geography was a favourite or most meaningful subject as it showed “how natural systems worked” (EE1) and had triggered an interest in the natural outdoors. EE1 reflected: “Geography allowed you to physically interact with the world around you” (EE2). Factors for subject choices included choosing what they enjoyed or that they were inspired by a teacher they liked. The data revealed that in terms of selection of subjects in Grade 10, career choice did not feature as many were not sure what they wanted to do beyond heading in the general direction of a science career. EE1’s subject choice of industrial arts was the most significant atypical subject choice (compared to others in the case sample), but he was inspired by the principal of the school and seemed to enjoy the subject very much. He further outlined that it was the industrial arts school trip to the Knysna Forests (EE1) that generated an interest in outdoor things.

The evidence reflects very little representation of environmental career orientation experiences during schooling broadly. There is no evidence in these stories of meaningful career guidance. All interviewees reported that they had received no career guidance or information on any environmental career during their schooling. This is not unusual and, as discussed in the Rosenberg et al. (2009) study, knowledge about the scope of environmental careers is limited (see section 5.6.). As discussed in section 6.4 and from the data in these cases, career programmes within engineering at school or post-school level do not profile the specialisation of environmental engineering. Only one respondent noted that a key trigger event was attendance at a career expo that introduced him to a career in landscape architecture (EE2), which in turn led him to connect “built environment to architecture”.

The data across the nine respondents also revealed that transition between school and university was strongly supported by family and social networks. EE1 reflected on being part of the Scouts¹³ and spending many days in Delta Park Environmental Centre grounds “looking for owls in the trees”. EE4 reflected that his family growing up were “minimalists” so he was always taught to “use as little as possible”; he also reflected on giving up meat and is still currently a vegetarian due

¹³ Scouts is an outdoor adventure social community.

to his opinions on animal cruelty. EE2 reflected on the opportunity created by a family member for him to visit a company doing landscape architecture work; it was here that he was introduced to the environmental component in landscape architecture and this introduction remained a significant influence in his career and throughout his work life. EE5 reflected on how his grandfather (a mining engineer) arranged for him to speak to environmental scientists in mines and mining engineers.

All interviewees reflected rational decisions to enter university and were able to rationalise their study in an engineering related field. The extract from EE2 highlighted some of this rationalising:

When I was in my matric year I had to decided I had to go into a field associated with geography largely, but I also had this nagging thing that I also like the built environment as well as architecture and I really liked to plan things so it's right, finding the right solution, so I thought about town planning. But then at an expo I learnt about landscape architecture and read a lot about that and at the stage it was a new profession in South Africa. I then went to some offices doing landscape architecture work and they were busy with environmental related work and this is where I realised that this is what I wanted to be – a landscape architect and what I wanted to study...

Except for EE5 no other interviewee reflected any interest in an environmental career when they transitioned from school; however, a conscious choice in shaping a science related career biography was evident in all cases.

7.4.4 Understanding experiences of transitions into undergraduate degrees

All interviewees transitioned very successfully into university directly after secondary school. All entered science faculties. One entered Landscape Architecture (EE2) at the University of Pretoria, the only institution offering landscape architecture at the time. One (EE6) started a BSc (Genetics and Biochemistry). EE6 reflected that with her BSc she had no intention of entering engineering (her main interest was genetics). One entered Chemical Engineering (EE4) while the majority entered Civil Engineering. All except EE4 reflected that they had felt certain about what courses to study. EE4 reflected great uncertainty: he was aware that he wanted to study environmental and geographical sciences but with family engineering influences he decided on something environmental linked to engineering. His local university career counselling centre was unable to advise him and eventually told him that he needed to study chemical or civil engineering then specialise later; they weren't able to give him any information on engineering specialisations. He chose chemical engineering purely because he enjoyed chemistry.

Several interviewees received funding during their undergraduate studies – EE2 received a bursary from a government department in second year; EE5 received a government bursary for

engineering; EE1 and EE3 received bursaries from an engineering company. However, EE4 and EE6 reflected that they received no funding for their undergraduate studies. Funding as an enabling factor for university study has been recognised by various national studies (Rosenberg et al., 2009; Cosser, 2010).

The data reflects that several interviewees worked during their undergraduate studies. EE2 reflected that he had worked in a landscape architecture firm and the owner remained a mentor and significant influence throughout his professional life. EE4, EE1 and EE3 also worked at engineering firms. EE3 worked between two organisations, an environmental consultancy and an engineering consultancy; this generated his interest in hydraulics and had a tremendous impact on shaping his career and his current specialisations. In most cases, first jobs were strongly linked to vacation work sourced from social networks established during this work.

EE1, in his final year, started a BCom degree at UNISA through correspondence so thus overlapped degrees for one year. He reflected “I wanted more flexibility and I felt my technical courses would have limited application in the real world”.

EE5 chose an elective, which was environmental process engineering and met Prof. Harro von Blottnitz (who was a lecturer within their faculty). This played a significant role in helping him decide to specialise, as it was his first introduction to environmental processes and their consideration within engineering practices. He also reflected that in his fourth year, UCT had a specialisation open day, which presented students with some ideas of different fields of engineering. He was the only person of the nine respondents who reported on information gleaned for options specialisation.

With the exception of EE5, none of the others expressed any awareness of environmental careers during their undergraduate degrees. According to EE1 “at university the idea of specialising in environment never occurred to me ... it was not introduced ... it was very much a ‘fringe academic sort of research area’”.

Eight of the nine respondents (all except EE5) reflected that they learnt very little significant environmental knowledge within their engineering degrees. Only EE5 recalled a short course on environmental legislation, which she found very exciting. EE4 reflected:

I think engineering programmes don't have enough environment. Ultimately engineers design processes that impact on the environment all human development relies on environment for resources we need ... environmental designs and development needs to

be built into engineering. Drawback is when engineers don't have environmental knowledge.

With the exception of EE4, all other respondents transitioned directly into engineering workplaces.

7.4.5 Understanding experiences of transitions into postgraduate studies

Of the nine interviewees, three completed masters in environmental engineering. The discussion below illustrates their experiences of postgraduate studies. EE4 was the only engineer that transitioned directly from his undergraduate into a master's degree: "[the masters] was a stepping stone to where I knew I wanted to go ... I hadn't achieved the goal I had set myself" (EE4). He felt very strongly that he needed to do a coursework masters that enabled him to bridge some environmental knowledge and moved from his institution despite offers of funding for a full research masters. He completed a master's degree in environmental engineering and felt that the coursework helped him to build a broader environmental knowledge base. He enjoyed the broad scope of courses and felt it gave him good exposure to the field (EE4). EE3 did a masters in environmental engineering at UKZN; he entered the masters after working for four years. He reflected that he wanted to do a masters in water and wastewater treatment and could not find something relevant in South Africa so he 'settled' for the coursework masters at UKZN. As he was a specialist already (due to his work focus which was prompted by both his vacation work and his love for hydraulics) with very particular interests, he found that the coursework forced him to study many aspects that seemed irrelevant. EE8 was not educated in South Africa; he studied his undergraduate degree in environmental engineering and a masters in environmental engineering in Italy and redid a masters in environmental engineering at UKZN when he came to work in South Africa. He was attracted to the mining industry and felt the coursework would help him gain a better overview of engineering in South Africa.

EE6 studied a BSc undergraduate degree (as discussed in section 7.3 above); next she transitioned directly into a BSc honours followed by a masters in Biotechnology. She then entered an engineering company as an environmental scientist and worked with process engineering, developing a focus specialisation on waste. After working both in South Africa and in the UK she began a PhD in civil and environmental engineering at the University of Witwatersrand focusing on waste.

The three career stories reflect successful transitions into postgraduate studies; however, EE4 felt that "a masters needs to specialise not upskill" and EE3 reflected a need for specialised

knowledge. EE3 explained that the masters gave him the language to access and engage with other engineers and environmental professionals. O'Donnell, Tobbell, Lawthom and Zammit (2009) reflected that successful transitions to postgraduate studies are related to 'mastery of the practices of the community' (p. 31). The data in this case reflects the O'Donnell et al. view that respondents did not see postgraduate study as merely upskilling or 'engaging with learning materials at a higher level' (2009, p. 31); rather people reflected an interest to specialise, develop deepened knowledge and learn new practices. However, EE2, EE7 and EE5 all expressed that they had not felt the need for a postgraduate degree so currently do not have any postgraduate qualifications. EE2 explained that his decision not to do a postgraduate degree was based on feeling that the master's degrees were largely too specialist: they focused on either water, waste or energy and this was not suitable for consulting environments and the range of work he was involved in.

EE1 decided not to do masters in environmental engineering as well but instead chose other postgraduate degrees. EE1's decision to do an International Diploma in Project Management at Cambridge first was as a result of determining his biggest need within the workplace: "the value of having the ability to manage properly because that seemed to be the biggest sticking point, to be able to deliver technical information but to get it together in the right sequence at the right time". He consciously selected this course because it offered him an opportunity to combine three areas (property, economics and environment) in one course. His company refused to fund this as it was not regarded as engineering so he had to pay for this himself.

An important observation was that four of the seven South African engineers opted not to use the institutional pathway (envisaged by education system) and had instead crafted a non-traditional pathway to enable them to gain access to a specialism. The decisions to specialise were prompted by the types of projects they were working on and the type of knowledge they felt they needed. Recognition as an environmental specialist was also important. The data raises an important observation on the role of work exposure and workplace experiences for developing specialisations which people can then follow through into postgraduate qualifications to further enhance or extend specialisation competence.

7.4.6 Understanding experiences of transitions from education into work

Entry into work from study reflected a smooth transition for all nine respondents except EE4 and EE6 (EE6 however had a BSc honours). The others all transitioned directly into engineering jobs. The ease of their transitions from study into work could be attributed to being bursary holders.

However, EE4's transition into work raised interesting perspectives: he chose to transition directly into a postgraduate degree and he completed his MSc in environmental engineering. On completion he waited eight months before he could get a job, eventually relocating to Johannesburg to get a job with the help of his supervisor:

Entering the job market was a challenge, it appeared like there wasn't a demand for my skills so I initially felt a bit lost wanting to practice as an environmental engineer, I couldn't really find my space.

As seen from across the nine stories, the transition into environmental related work appeared to be largely an emergent and initially unplanned process while transitioning into the specialised field appeared to be mainly emergent in an ad hoc sort of way. According to EE1, engineers "stumble into this route in the workplace". As explained above, only EE4 reflected a rational decision to enter engineering and specialise as an environmental engineer.

Transitioning into a specialised environmental work role presented some challenges. A major issue appeared to be that the transitioning environmental engineers struggled to find an organisational fit. EE2 reported that he didn't have a work role: "they didn't know what to do with environment people" so he was placed into a unit called 'special tasks'. EE1 highlighted that "being the environmental guy in the office he was always treading a fine line being outspoken around issues and the core business focus". EE3 also reported that he struggled "trying to develop my knowledge in a specialist area and not getting drawn into general consulting". EE6 reported that she couldn't find a niche where she belonged and that she further struggled with balancing business and environment work; she stated it was "difficult being an activist in a business". Supporting their environmental development was difficult because "engineers work in silos" (EE1) and breaking this to promote integrated design approaches, especially when "environment was low on the agenda of senior management who are unable to see the benefits of dealing with environmental issues upfront".

A further dimension that presented problems for the respondents was the Human Resource division that also struggled with their not perfect fit. Respondents reflected they had to develop and shape their own career paths as human resources was unclear on how to do this from an unrecognised specialism. Human resource systems also struggled to approve courses as the short courses they chose were not mainstream engineering courses (EE6, EE1, EE7). EE1 reported that he has self-funded most of his studies post university.

The respondents reflected their specialist role in a company meant they were involved in various and varied projects. This created a huge need for new and changing knowledge: there was a constant need for new knowledge and keeping (yourself) in the loop (EE7) and being up-to-date (EE5).

The discussion of transitioning experiences from the career stories illustrates how once established engineering transition routes have now become more protracted and unpredictable, although this is not unrecognised elsewhere (Field, 2010). Their stories are a coherent reflection of how the emerging environmental discourse is being appropriated and assimilated into this established field of practice.

As shown by the respondents' cases reported on above, the learning and work transitions into an environmental engineering job are complex, and are extended over the life course of professionals. All interviewees displayed examples of multiple stepping stones to settle into a stable work role and their transitions could be described as **extended, complex, multiple and non linear** (Sawchuk & Taylor, 2010), especially in reflecting on how they gained access to the specialist roles. Their decisions in shaping their pathways reflected the need for transitions to be compatible with their past experiences, their interests, their knowledge and skills and, very importantly, their future aspirations. Heinz (2002) noted that "biography is the person's reflexive arrangement with the circumstances and contingencies of the life course which is socially structured by constraints and opportunities" (p226).

7.4.7 Surfacing patterns of mobility inherent in learning and work transitions

Sullivan and Baruch (2009, p. 1542) proposed that rapid, unforeseen and unexpected challenges are raising challenges for traditional careerists and are "creating changes in how individuals enact their careers" within these transitioning spaces. To surface dimensions of occupational progression I used the construct of job mobility. Job mobility, as discussed in section 4.4.2.6, reflects patterns of inter- and intra-organisational movement. Ng et al. (2007) argued that mobility is central to understanding how careers unfold. This helped me to surface and illustrate numerous inter- and intra-organisational job moves, which are evident across all stories under study in this chapter. In outlining the mobility patterns, I used mobility typology of Ng et al. (2007) who outlined types of job mobility (see section 4.4.2.6.). In early career stages, the data depicts a smooth transition from student to employee (candidacy period): internal upward movement

(upward movement within same organisation) as described by Ng et al. (2007) is depicted in EE1, EE2, EE3, EE5 and EE7.

A break in employment and periods of unemployment was displayed only by EE4 and EE6. Both experienced a period of unemployment before entering the job market. EE4 was very stable once he eventually got a job after eight months, but EE6 moved between various occupations and work roles until she settled into an engineering consultancy. Job shifting (number of changes between employment statuses and jobs – Bradley and Devadason, 2008, p. 127) and yo-yo movement (movements between full-time, part-time and temporary work; periods of study or training; self-employment or voluntary work; unemployment and travel – *ibid.*, p. 129) were only visible in EE6. All other eight respondents could be described as displaying patterns of ‘sticking’ which shows evidence of pursuit of a single type of career and ‘settling’ which shows patterns of stability after initial shifting (making a conscious choice to settle into a single occupation) (*ibid.*).

The transitions between levels of responsibility and lines of accountability are regulated in engineering through the professional body (In01; In05). However, transitions into management/technical roles were studied more closely in the nine career stories and this reflected two key types of mobility patterns. Firstly, in all nine stories there was extensive intra-organisational movement (Appendix C), which can largely be viewed as lateral movement promoted by project-based work. The changing nature of work and how this ‘projectification’ has influenced work is discussed in greater detail later (see section 7.5.4.3). The second observation is clearly depicted in the career stories of EE2, EE4, EE5, EE6 and EE7 where frequent job moves between two organisational types – engineering consultancies and environmental consultancies – were observed. Visible occupational and organisational change is evident in all nine respondents’ stories involving internal and external lateral movement.

Despite entering from different paths (chemical engineering, EE4; landscape architecture, EE2; civil engineering and BSc, EE6), the data across the nine cases shows a strong preference for and intention to engage in environmental combined with engineering options. The mobility patterns in all nine case stories (see Table 7.4. below and Appendix C) thus became depictions of **work role transitions to facilitate the development of specialist competencies**. The extract below shows job moves of one interviewee (EE2), a more comprehensive table depicting mobility patterns of all nine is attached as Appendix C.

Table 7.4: Job mobility patterns of EE2

	Work during study	Work after university				
		1 	2 	3	4 	5
EE 2	Landscape Architects and Environmental Planners vacation work	Department of Water Affairs  Special Tasks Division Technician  Design Services Division – Landscape Architect	Environmental consultancy  Environmental officer	Engineering consultancy  Landscape Architect  Associate	Environmental consultancy  Associate  Senior Associate  Director	Engineering consultancy  Director – head of environmental division  Competency Leader for Environmental Works - Africa and Middle East regional team

The mobility pattern across the nine cases clearly depicts non-linear occupational progression. Unlike the official institutional pathway discussed above in section 7.3.2, which shows parallel ascending movements, the pathways of the nine environmental engineering respondents in this study (see Table 7.4) show a more sideways movement. Furlong, Cartmel and Biggart (2006) proposed that a range of experiences could be defined as linear and non-linear. They emphasised that “non linear transitions involve breaks, changes of direction and unusual sequences of events. They can involve extended or repeated experiences of unemployment, frequent moves between jobs and returns to education and training after periods in employment” (p. 231). The experiences of the environmental engineering cases in this study do not concur with the Scottish experiences of Furlong et al. (2006) who maintained that people with high levels of qualifications (especially degree or equivalent) are more likely to follow linear transitions.

These non-linear mobility patterns (described above and shown in Table 7.4.) raise key challenges to the idea of a linear developmental trajectory for environmental engineering professionals envisaged in an institutional pathway and hence raise challenges to the normative pattern of an environmental engineering pathway. The data shared above appears to show that there are complex lateral job movements and these job movements are catalysed by a broader environmental change, which has raised needs for different work contexts, responses and experiences.

In many instances, mobility and transitions are ascribed to 'choice biographies', described by some theorists as a result of increasing individualisation of society. But the dimension driving movement in the context of the nine career stories shared above appear to also be associated with the need emerging from changes to labour market demands driven by environmental policy change (In06), environmental concerns, skills needs and shortages and new government priorities, as discussed in Chapters 1 and 3, and their appearance and visibility within engineering projects. Ibarra (2004) highlighted that external labour market forces ultimately determine what work /project options are available, changing occupational configurations and creating new choices such as contract work and ultimately supply and demand showing certain structural influences on the transitioning processes. The data in these nine career stories highlights that an understanding of job mobility and career transitions can offer evidence about the way in which wider social, economic and environmental patterns can affect individual transitions (Raffe, 2008).

7.4.8 Transitions between forms of learning: Formal and informal learning

The nine career stories presented above illustrate the significant role of learning throughout the life course. As work practices begin to change and new work roles emerge, the need for supporting regular and continuous learning becomes evident (In. 02; In 05; In06). Glastra, Hake and Schedler (2004) proposed that all lifelong learning could be understood as transitional learning. They referred to this process of shaping one's biography as 'transitional learning', which is supported by Field's (2012) assertion that all lifelong learning is transitional learning. The quote below presents a useful orientation:

Transitional learning emerges when individuals are faced with unpredictable changes in the dynamics between their life course and the transforming context, and when they are confronted with the need to (learn to) anticipate, handle and reorganise these changing conditions. This situation triggers a continuous process of constructing meaning, making choices, taking up responsibilities and dealing with the changes in the personal and societal context. (Wildemeersch & Stroobants, 2009, p. 222)

The career stories all depict evidence of transitions between different forms of learning. Although formality and informality in learning is a relational continuum (Colley et al., 2003), to help me understand how people developed their new field of knowledge within work and learning, I used the typology of Sawchuk (2008). It provided a useful construct that helps one understand the interrelated nature of formal, informal and non-formal learning (see Chapter 4, section 4.4.3.2). The nine career stories referred to in this chapter all display clear examples of the full range of variation of learning and experience. This combined role in enabling the transition outcomes, illustrates how important all forms of learning were in enabling occupational progressions for the nine environmental engineers under study.

As discussed above, all nine respondents engaged in formal learning processes and then transitioned into workplaces. Within workplaces they “stumbled into environmental work” (EE2) and had to engage in learning in and through work (Billet, 2009) while working on their work projects (EE1 stumbled into his green building specialisation; EE2 – numerous transitions across different fields enabled his transition into leading a large environmental engineering international division; EE3 transitioned into a water and waste water specialisation; EE4 travelled a long winding road ultimately evolving into a waste specialist in a large engineering company). This work experience, amongst all respondents, appeared to facilitate further placement in environmentally related projects, building experience and learning as they emerged to be seen as “the environment guy in the office” (EE1). The lateral movement into different types of environmental projects served as an opportunity to build specialised environmental knowledge. All respondents provided great detail on the different types of projects they were involved in as illustrated in the case example below.

Although EE5 is a registered environmental auditor, since her undergraduate engineering degree she had done no formal courses; all her learning has been through work experience, informal and non-formal learning. The example from EE2 below illustrates further the inseparability of work and learning and how informal learning through work can prompt and enable occupational transitioning – currently EE2 is the “environmental service line leader for (my company) globally ... I align resources from Australia New Zealand, Africa and UK”.

Extracts from Career Story of EE2

Joined Water Affairs in special tasks. We worked with engineers who had a lot of depth and skills and we slowly started to grow a whole new sense of working and environmental awareness. Initially we were involved in rehabilitation only fixing up after senior engineers but slowly we started to get involved earlier in projects and started to change how engineering teams plan their projects so we can have less problems at the end. When I left after six years we had developed a whole process of planned projects involving environmental screening. I think in terms of professional growth you need to have a diverse sort of experiences when you are a junior person. For me I think water affairs was fantastic, they were at that stage doing massive construction and they did all of their dams on their own, didn't use outside contractors so there was this massive earth moving projects and I gained experience and understanding on what construction and earth moving was all about.

I joined an engineering consulting firm where I got involved in various projects ... thereafter I joined Lesotho Highlands Water Project as I needed more onsite environmental experience. Under phase 1a and phase 1b. Phase 1a was more of an onsite environmental experience totally new site based environmental staff – involved in day to day running of a project – it was lonely but the buck stops there. On a site the construction is happening everywhere and they come to you to ask can we do this? You research quickly – before computers ... find right answer, that was vital and I think that period was when you needed to take responsibility and make decisions as the construction was going on. You also needed to research quickly and find the right answers and then actually be able to defend your answers to the engineers and ensure that they implement it ... it was probably the most important learning experience that I had which shaped my career.

New knowledge development depicts an interplay between work experience and formal courses. Only EE3 and EE4 did masters in Environmental Engineering. EE1 did an MSc in Built Environment Science and EE6 did an MSc in Biotechnology (Waste) and then a PhD in Environmental Engineering (see Table 7.3 above). This learning was supplemented largely by short course-based formal learning. The data reflected 66 short courses between the seven interviewees (that provided information on the courses they had attended). Of these, 44 % were environmental, 30% engineering related and 26% more general (business writing; communication, computer, powerspeaking) (AM3). The dominance of environmental courses reflects an interest and need to develop specialised knowledge. The range of courses included green building technologies; environmentally sustainable design; environmental law; integrated environmental management; energy efficiency technology; EIAs; underground environmental control, bioethics – list in Table 7.5 below. This range is reflected in their consulting work environments and hence articulated a need for a diverse mix of environmental knowledge and skills. Some respondents also reflected that they were reluctant to enter a postgraduate specialisation as some of the master's courses are too specialised in one area (e.g. waste and water) (EE2, EE5, EE7).

Table 7.5: Summary of Environmental Short Courses done by interviewees

Green Building Technologies
Environmentally Sustainable Design
Built Environment Related Computing for Design & Analysis
Environmental Law Update, North-West University Potchefstroom Campus
Underground Environmental Control, Chamber of Mines S.A
Integrated Environmental Management
Environmental Law
Integrated Environmental Management, Legal and Administrative Principles, University of Cape Town, South Africa
Legal and Administrative Aspects of Integrated Environmental Management (IEM), Practical Techniques, University of Cape Town, South Africa
Environmental Impact assessment
Environmental Management at UCT
Energy Efficiency Technology - done course at national cleaner production centre but not aware of accreditation for the course
Applied Ethics (Bioethics)
Design of waste disposal systems
Design of Solid Waste Disposal Systems, University of the Witwatersrand, Johannesburg
Hazard ID and Risk Assessment of (Trans)gene Flow, University of Tromsø, Norway
International Association of Impact Assessment South African National Conference, International Association of Impact Assessment South Africa (IAIASa)
WasteCon 2008, Institute of Waste Management of Southern Africa (IWMSA)
Environmental Law Update, North-West University, South Africa
Internal Assessor / Moderator Course, Africon, South Africa
Protocol for Risk-Based Evaluation of the Performance of Waste Disposal Sites, South African Institution of Civil Engineering (SAICE)
Business Writing Skills, Pula Madibogo
Role of IT in Management of the RSA Environment, South African Institution of Civil Engineering (SAICE)
Environmental Auditing, University of Potchefstroom, South Africa
Environmental Law, University of Potchefstroom, South Africa
Environmental Management Systems (SABS/ISO 14001), University of Potchefstroom, South Africa
Introduction to Environmental Management, University of Potchefstroom, South Africa
Microsoft Access, Finlore Education
Environmental Governance, University of South Africa (UNISA)

(Note: Only seven of the nine engineers provided data on the short courses attended – as this was to be mailed following interviews)

Non-formal learning supported through mentors was evident in EE2's response who reflected on three significant mentors in his work life. Other respondents (EE2, EE3) noted that they had mentors within work development programmes (as is necessary within engineering firms) but that this was essentially 'on paper' (EE1) and hence they did not list mentors as significant to their learning.

None of the interviewees responded that they belonged to an informal professional community of environmental engineers despite registration with ECSA and their voluntary associations. EE1 belonged to the Green Building Council and explained that,

In 2005 the Green Building council was formed and that was the catalyst because it presented an opportunity for me to get involved from the outset. Fortunately my company X was a sponsor so I had a good chance of getting into technical advisory group ... became an assessor for projects ... it has given me the interface with likeminded professionals from different sectors.

EE2 belonged to the South African Council for landscape architects as well as the International Association Impact Assessment (IAIA); EE4 is a very active member of IAIA and is currently the Western Cape Chairperson for this association; EE5 is a registered environmental auditor with the Institute of Environmental Management and Assessment, UK. The data reflects that three of the nine professionals involved in this study are active members of two professional communities and have conscientiously joined professional networks that are not directly related to engineering. They all (except EE4) reflected that they had never rationally chosen to enter the environmental sector and they currently straddle two professional communities.

The discussion above illustrates that the nine engineers involved in the study are actively engaging in upskilling and re-skilling beyond organisational boundaries. The evidence indicates that they have taken active responsibility for their own learning and have subsequently crafted a path across into new fields of practice. Livingstone (2012) reminded us that individuals "inherently cope with their changing environments by learning" (p. 61).

The nine career stories depict a flow in and out of structures defining their subject position, immersing in and breaking away from boundaries, knowledge identity, community, and scope of practice. Fenwick (2013) highlighted that many contemporary workers operate with a central tension – a simultaneous attraction in two conflicting directions – towards becoming and anchoring a bounded subject position and towards escaping or flying these boundaries (p. 23). Freedom is evident in the new practices and spaces of subjectivity that open in their nomadic movements across organisations, knowledges and working relationships. The discussion illustrates

that environmental engineers (to become environmental engineers) are, by necessity and choice, actively engaging in upskilling and re-skilling beyond organisational boundaries and the evidence indicates that they have taken active responsibility for their own learning and have subsequently crafted a path across and into a newly emergent field of practice that appears to have relevance for the Green Economy and sustainable development of South Africa (Du Toit & Roodt, 2009; South Africa. DEA, 2010a; South Africa. DHET, 2013b).

The learning and work patterns reflect personal adaption to new, emerging work roles which can also be viewed as self initiated, highlighting agentic dynamics as being influential in the transitional process. This work role transition process is not guided by institutionalised transition processes and involves elements of separation and incorporation simultaneously (e.g. a number of the engineers physically left engineering companies to work in environmental consultancies and returned to the engineering sector subsequently, and those who were in the engineering sector were seen as 'part outsiders' as their occupation was not a 'normal' version of engineering practices). Such a condition surrounding the occupation makes for a difficult transitional process (Ibarra, 2004).

Transitioning into a specialised environmental work role presented some challenges. A major issue appeared to be that the environmental engineers struggled to find their organisational fit, reporting that they didn't have a clearly defined 'work role'. As one respondent highlighted, being the environmental guy in an engineering organisation he was always "treading a fine line between being outspoken around issues and maintaining the core business focus". Several of the environmental engineers reported that they struggled to find a niche as noted by one engineer who further struggled with balancing business work and environment work. She claimed it was 'difficult being an activist in a business'. The stories indicate that most of the engineers had to wrestle with uncertainty and incomplete information, which are a natural feature of a less bounded organisation and the nature of boundaryless work where the people, the contexts and processes are always changing. Arthur and Rousseau (1996) highlighted that in these instances of uncertainty "people fill in the blanks, people making sense of uncertainty enact a structure in which to work. Micro-level processes shape macro level organising" (p. 21). All nine career stories reveal a dual learning process – on the one hand a realisation of their own fluidity continually escaping the fixed subject position allotted by the 'normal' engineering workplaces and, on the other, an engagement with 'external concerns' such as environmental concerns which reflect a growing awareness of their own subjectivities and their role in producing these subjectivities in

the engineering organisational context (Fenwick, 2006).

The next section provides a meta discussion of the underlying factors that shape learning pathways for environmental engineers.

7.5 Factors influencing learning and work transitioning within environmental engineering learning pathways

7.5.1 Overview of this section

In this section I will elaborate on the factors that influence learning pathways of environmental engineers as established in this study. Critical realism upholds that how people reason their actions does not constitute the only basis for how and why they act. Structures predate agents and are hence a necessary part of their action (Bhaskar, 1993). The experiences of transitions outlined above clearly depict that the institutional and structural factors that shape transitions are broader than education and training only. They are intermingled with the labour market (nature of the work and availability of jobs); human resource systems; family structures and social relations; and the [changing] environment itself.

As indicated in section 1.4., one of the interests of this study was to surface systemic and occupational insights that impact on learning work transitions. Framing any meaningful intervention in a systemic context would need to be cognisant of broader contextual factors within which learning work transitions are enacted. In framing this discussion, I used abductive analysis (see section 5.7.1.2), drawing on key ideas within learning pathways and learning and work transitions research to make sense of the data. In writing this section, I am wary of being victim to methodological individualism as outlined by Price (2007). She described how critical realism cautions us against methodological individualism, which happens when one only takes account of what is said by people and discounts other factors. In response, I have endeavoured to discuss both the systemic elements and the career stories insights shared above.

Sawchuk and Taylor (2010, p. 12) argued for transition work to raise the social variables associated with learning to work transitions. This study has broadened the discussion to include the social-ecological variables associated with learning and work transitions. It aims to understand how non-linear transitions emerge, the complexity of transitions, and the need to attend to broader institutional arrangements within and across education and training, the labour market and the workplace.

7.5.2 Available signposts: Information and guidance

As discussed in section 6.6, information and guidance on green careers are marginal within priorities at school (OECD, 2000), especially poorly resourced schools. The findings of research shared in section 6.6 illustrates that guidance and information for environmental careers is generally poor and poorly disseminated within South Africa. This discussion focuses more specifically on the representation of the environmental engineer occupation in career orientation literature and resources.

All respondents in this case indicated that career information was very sparse during their schooling and they had not learnt about environmental engineering as a career option at school. Environmental engineering as a viable career is not easily visible across stories. They had all struggled to see a career path into this job and were essentially unaware of it (with the exception of EE4 who had the idea he wanted to do something in engineering and environment but was essentially unable to find coherent information). At school, they had received no related career information and at university, the opportunity to specialise in environmental engineering was never highlighted. A systematic approach to information and guidance during the transition phase from schooling to higher education appears to be lacking.

Well-resourced schools utilise career resources like PACE (see Chapter 6, section 6.10). Various environmental agencies produce career brochures but unfortunately distribution of these is very localised. As discussed in section 7.3.5., career information is fragmented, inaccurate and incomplete. OECD (2000) elaborated on the importance of good information and guidance in enabling successful transitions. They suggested that as education and employment choices become more complex, the need for good information and guidance is critical, especially in areas where the pathways reflect growing flexibility and options (ibid.).

The respondents provided a similar response to information on career information obtained at university. All, except for EE4, reflected that they had not been introduced to the option of this specialism. This highlights the critical importance of developing coherent information for university students that enables access to the specialisms. In the December 2011 Biodiversity Human Capital Development career research, a similar finding was highlighted (Togo et al., 2012). University counselling centres were unable to give researchers coherent information on what to study to become an environmental engineer. Information for existing students is equally insufficient: all respondents (except EE4 who reported on a specialisations day in final year),

reported that they were not introduced to an environmental engineering specialism before they left university. This can be a significant issue constraining decisions to specialise as noted below:

... knowledge or awareness of careers in the environmental field might be one of the most significant factors limiting the number of students choosing to study towards such careers. (Rosenberg et al., 2009, p. 4)

This research further noted that “teachers as well as departmental officials have very limited knowledge of the current scope of environmental careers” (ibid., 2009, p. 11) which further constrains information access in the transition from school to work.

7.5.3 Range of opportunities and options: Availability and quality

7.5.3.1 Availability of options

The evidence of available qualifications (see section 7.3.2) clearly indicates that the predominant institutional pathway is an undergraduate degree and then a masters. A similar type of option exists in both academic and technical routes (section 7.3.2.)

However not all institutions offer postgraduate masters and BTech specialisations (section 7.3.2.). A further constraint is that postgraduate degrees are mostly specialised – in water, waste and energy e.g. Stellenbosch masters in environmental engineering is focused on water (section 7.3.2.).

The career stories of the nine practitioners who were the respondents in this study reflect a long, winding pathway that is costly, resource intensive and heavily reliant on individual agency and choice. The stories further depict accounts of **extended transitioning** where some have taken up to eight years to gain their specialist subjective position. For some, this involved multiple entry attempts, spells of unemployment and underemployment. This may have implications for critically reviewing the absence of specialisation options for environmental engineering in undergraduate engineering programmes, especially in the light of the finding reported above that the current South African picture appears to show a dominance of **extended transitioning** as the key feature of how environmental engineers in South Africa are trained. As noted in the introductory context section, this is not the same as in other countries, where environmental engineering is a recognised undergraduate specialisation option and a recognised engineering profession specialism. Te Riele (2004 p. 254) highlighted the “role of negotiation of structures of opportunity and risk in a risk society” that influenced what choices were possible. The challenge in a country like South Africa is that risks and opportunities are not evenly distributed. Social and material resources needed to overcome ‘risky experiences’ are also unevenly distributed, thus long winding paths are disadvantageous for poorly resourced learners. This is a significant consideration in

South Africa and within a sector that is struggling to transform.

7.5.3.2 Quality of training available

This study has not investigated the quality of training options available but what has emerged is that perception of poor quality can constrain learning pathways. This is evident, for example, in responses from EE1 who has done courses in both Germany and the UK and stated it's the "quality rather than the sourcing, especially in terms of expertise of presenter and international recognition. There is a definite lack of specialists ... the UK has good courses in Energy because of the EU regulations they have to meet". He thus raised the point that credibility and expertise of courses and expertise of presenters are critical: "not courses where presenters read a textbook and it becomes a lecture" (EE1). EE3, who left to join a UK company when he wanted to specialise, stated that courses are just poor quality and presenters lack specialist competence. He claimed, of the continuous professional development courses he was compelled to do within South Africa, "I haven't found them valuable, in ten years I may have learnt two new things".

7.5.4 Understanding the changing nature of work

The changing nature of work is evident in the dynamic interrelationship between learning and work as well as the prevailing shift to project based work.

7.5.4.1 Responsive workplaces

There is good indication from the discussion above that within engineering workplaces there has been a definite increase in environmental work. This was corroborated by interviews and HSRC research (HSRC, 2009; In03). All stories reported experiences of unplanned transitions into environmental work resulting from demands in the workplace, resulting from needs in the projects they were working on. This is corroborated by observations by In03. The workplace has an important role to play in mediating learning. Thus workplaces remain critical sites for skill specialisation and development of specialised knowledge. Their role in creating opportunities for collaborative practices is critical. Embarking on professional practice that **will** challenge boundaries of professions needs supportive workplaces (EE2; EE3).

7.5.4.2 Work experience combined with education

All the career stories reflect blurred boundaries between education and work: it is difficult to restrict transition to a set event. These stories illustrate that transitioning into work is not a single event; all were working while studying and gained valuable work experience during their studies as illustrated in the stories of EE1, EE2 and EE7. The discussion highlighted how EE3's

mentor/teacher was critical in supporting decisions related to specialising. EE3 also reflected on how the work experience was critical in supporting his knowledge development: the best marks he got were for hydraulics which was his vacation project work. While engaging in work, especially within new projects, the need for diverse forms of expert knowledge and specialised skill was evident. Greenwood (2008) outlined that an important area that needs to be reviewed when we look at skills specialisation in an occupation is the field of knowledge required. These stories indicate that critical to the skill specialisation and development of specialised knowledge, are the interdependent roles of work and experience. All raise new demands so employees were engaged in learning informally and in formal learning through short courses.

7.5.4.3 Projectification of work

The transitional experiences of the engineers in this research are made significantly more complex by the fact that work is largely project based within consulting environments. Fenwick (2013) outlined that this change in work “demands new capacities among professionals in patching together diverse knowledge and negotiating work infrastructures and governance quickly” (p. 4).

Reflecting on work in the construction sector in Sweden, Ekstedt (2007) raised some very pertinent points related to the shift to project based work. Project based work is characterised by tight deadlines and a focus on results and performance demands which creates stress. EE4 explained his experience of transitioning into project work: “straight into consulting work was very difficult ... it meant you already had to be a specialist without having worked in the processes, so you are thrown in the deep end and you eventually discover how processes work”. Ekstedt (2007) explained that individuals are learning throughout the project based on tasks that are their responsibility, resulting in companies often forfeiting training outside project work in favour of ‘on-the-job training’ (as reflected in the career stories of ES2 and ES4). This results in promoting as described by Ekstedt (2007) a transition away from organisation-based knowledge to more individual based knowledge. A critical consequence of this transition is that individuals must assume more responsibility for their careers and Ekstedt (2007) proposed that a key feature is that this project-based work is focused on expertise and people have to market and profile their competence.

Ekstedt (2004) highlighted that “in one single workplace up to one hundred different organisations could be engaged. Although there are great variations of organisational solutions within the sector, they are always project based” (p. 4).

7.5.5 Mixed messages – the importance of signalling

There is evidence throughout this chapter of incomplete and mixed messages (sections 7.3.3 and 7.3.5). There does not appear to be a general systemic understanding of what environmental engineering is, what work an environmental engineer does and what a candidate needs to study to become an environmental engineer. The discussion has shown inconsistencies in career information, both within the engineering sector as well as the national career portal (section 7.3.5.). Universities are unable to give learners clear information on what to study or how to get there (Togo et al., 2012). Within occupational frameworks (OFO) (as discussed in section 7.3.3.), environmental engineering is now regarded as an occupation; however, observation data and field notes indicate that this is very differently understood in the engineering sector (FN8; FN9; In05; In03). Some within engineering regard it as a specialisation of Chemical Engineering, some as a specialisation of Civil Engineering and some regard it as an unnecessary job as civil teams can work with an environmental manager (In 06). This reflects a complicated picture of how the labour market understands this job. The challenge then is that if the labour market cannot identify with the occupation, graduates struggle to find employment, as can be seen in the story of EE4 (who, as a young graduate with a masters in environmental engineering, failed to secure a job for about eight months).

The following discussion by Breen (2005 p126), reflecting on analysis of data from 27 OECD countries is useful. He explained:

... two key aspects determine how people fare once they leave education; the degree to which educational systems inculcate specific rather than general skill, the extent to which there are direct links between education system and employers ... a greater emphasis on specific skills and a closer link between schools and employers lead to an easier transition from education to labour market because they send a very clear signal to employers about the potential productivity of a given job seeker.

Thus the discussion illustrates the important role of signalling. To enable smoother transitions, people need information, guidance and systemic articulation that enables the education system to signal effectively to the labour market the suitability of a particular job seeker for a particular job (Sawchuk & Taylor, 2010); Breen, 2005). I would add though that in this case we can see this as a two-way process i.e. sector signalling into the education system (as illustrated in the discussion from Wits University) is also important.

7.6 Mechanisms influencing learning and work transitions in environmental engineering

This case of environmental engineers as described across this chapter illustrates that the system did not anticipate the demand for this emerging occupation. The education system was hence unprepared and now South Africa is faced with trying to develop new skills with a pathway that is reliant on the agentic processes of an individual, without adequate systemic 'infrastructure' to respond to this substantive scarce skill need.

In this research, the critical realist lens enabled me to shift focus from events that can be empirically observed and experienced to develop a clearer picture of the mechanisms that have produced the events and experiences. Drawing from the history and context outlined in sections 7.2 and 7.3, the empirical reality that emerged from the career stories and the systems overview, I then used retroductive analyses from critical realism and tried to establish the causal mechanisms that could be influencing the environmental engineering pathway.

As a basis for the inference to conclusions about generative mechanisms, it was necessary to collect data that gave me information about the reasoning of different stakeholders. The figure below illustrates the interacting mechanisms and the shaping of their experiences of building their pathways to green jobs.

Table 7.6: Outlining causal observations

Causation Diagram	
EMPIRICAL Ad hoc transitions Long protracted learning pathway into specialisation Active upskilling and reskilling	
ACTUAL Poor workplace skills planning Strong mentorship and role models Labour market forces drive work/project options Rapidly transitioning social and ecological world Rapidly changing work contexts and needs Dual subjectivity processes – ‘normal’ engineering and growing awareness of own subjectivity Professional networks Professional bodies Differing institutional and individual pathways Agentic dynamics – will /motivation for self-specialisation Legislative requirements	
REAL Reactive labour market and skills analysis System maturity System transformation Dealing with newness – emergence of new occupational needs Transitioning society	

A prevailing observation is that access to the specialism is reliant on agentic processes of individuals who appear to be on a pathway that is not very transparent, lacks signposts and hence is characterised by non-linear progressions into environmental engineering jobs that are not institutionally or occupationally determined. The dominant picture is of agents navigating their own non-linear pathway, moving in and out of education, paid work, participating in different projects and developing specialised knowledge and experience which enables their eventual transition into an environmental engineering job.

Despite an obvious emerging demand, there appears to be a slow response from education and work systems. This illustrates that the national labour market intelligence system did not anticipate the demand for this emerging occupation. This demonstrates a reactive system lacking the ability for futures orientated demand insights, confirming findings of the DEA (South Africa. DEA, 2010a) study that reported a largely reactive skills system to environmental concerns (ILO, 2011a). The education and training system was unprepared and now the country is faced with trying to develop new skills with a pathway for environmental engineers that is reliant on the agentic action of individuals, without adequate systemic 'infrastructure' to respond to this substantive scarce skill need. This raises the issues of system immaturity and the inability to deal with 'newness'.

7.7 Conclusion

Raffe (2003) has emphasised that to design effective policy we need to understand the real pathway so we can determine if the pathways on which policies are based correspond to the way pathways are actually experienced; if they are not, policies can be flawed. The evidence presented in this chapter has raised some interesting observations on how official maps of pathways are understood. Despite official pathway maps showing parallel ascending movements, the empirical career stories show more sideways navigations and flexibility. The lack of signposts may also increase the disadvantages of young people who lack resources to make longer transitioning journeys.

From a critical realist perspective, this chapter has attempted to outline largely the *actual* (phenomena and events, generated by underlying structures/ causal mechanisms) and the *empirical* (phenomena and events experienced by the knowing subject) (Norrie, 2010) while the factors influencing pathways started unpeeling the layers of the real. But we need to take note of Bhaskar's critique that operating only at the level of the actual and the empirical, provides a false flat and purely positive conception of reality. Hence further analysis is presented in Chapter 8 that will outline what is absent from the actual and empirical which provides a means of identifying opportunities to consider as options for transformative praxis.

CHAPTER 8: ENVIRONMENTAL SCIENCE

Environmental science as a discipline is at the forefront of examining the complex relationships that make up the entity of what are now being labelled as socio-ecological systems, where human well-being is recognised as being firmly entrenched in the health of ecological systems.

Shackleton et al., 2011, p. 2

8.1 Introduction

In this chapter I explore the learning pathways related to the environmental science occupation. Although a relatively well-known occupational group, the research into this occupation was motivated by field-based engagements, which raised the challenge that South African skills planners appear to be unclear about who, environmental scientists are and what they actually do (In10).

In this chapter I investigate the learning pathways of the environmental scientist. To begin, I examine environmental sciences as a discipline within the sciences in South Africa and then explore its emergence as a field of practice. The chapter presents an account of how the occupation is viewed within workplace practice and how it is framed by official supply systems. These are then augmented by the career stories of environmental scientists practising in a range of workplaces in South Africa. Based on the challenges raised within both the institutional and individual pathways analysis, I synthesise some of the key factors shaping the learning pathways of environmental scientists in South Africa.

8.2 The context of Environmental Science

8.2.1 Broad scoping of environmental science internationally

Environmental Sciences has been regarded as a discipline in the UK from the 1960s (Smith, 2011). Smith further explained that its emergence was largely due to the belief that traditional academic disciplines like geography and biology “did not have the breadth of expertise to address environmental concerns” (p. 26).

The evolution of the discipline in the UK has shown trajectories that illustrate collaboration between biological and social science, or earth sciences and environmental chemistry. This has enabled and resulted in a variety of specialisation options within environmental sciences as depicted in Figure 8.1.

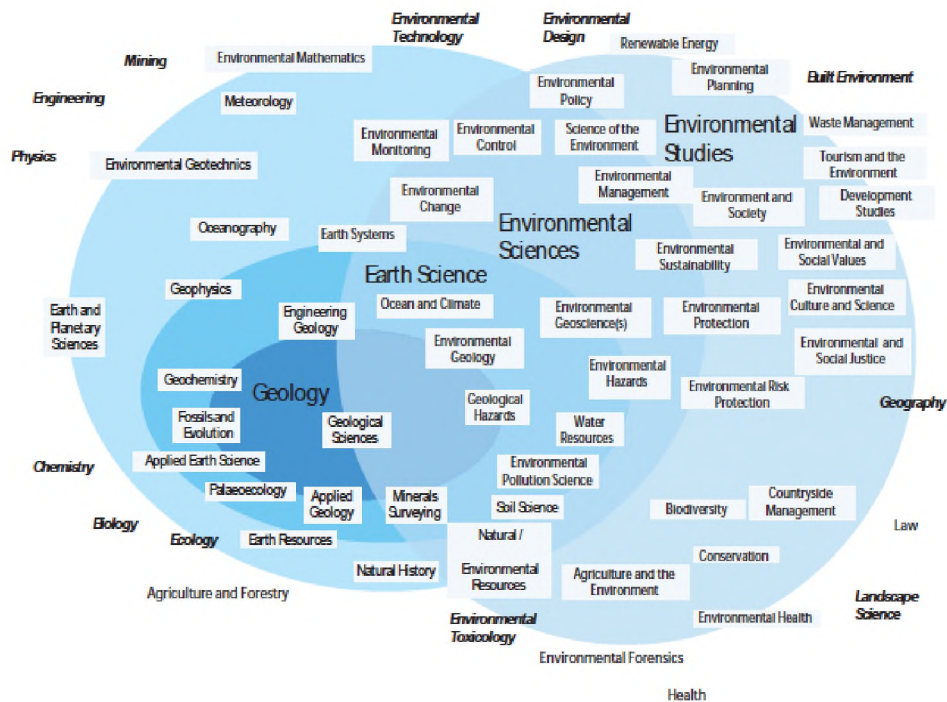


Figure 8.1: Mapping the subject fields aligned to Environmental Science (Extracted from Blumhof & Holmes, p. 7)

Smith (2011) raised some important points related to these wide varieties of specialisations (Figure 8.1.) which, he argued, ultimately results in a wide diversity of understanding, knowledge, skills among environmental science graduates and this has created “uncertainty in employers’ minds around the characteristics of environmental science graduates” (p. 27). Thus, after 50 years, employer understanding in the UK around capabilities of environmental science graduates is still very poor compared to more traditional academic disciplines (ibid.). More positively though, this has enabled environmental scientists to work in a variety of contexts thus providing routes to a variety of specialisation options.

8.2.2 The context of environmental science in South Africa

Environmental scientists today work in environmental consulting firms, conservation agencies, all levels of government (national, provincial and local), private companies like mining and engineering firms, research institutions and some non-governmental organisations (like World Wide Fund and Endangered Wildlife Trust). Driven by emerging environmental legislation (see Chapter 3), environmental impact assessments are becoming mandatory for new developments. There is a well- documented need for environmental professionals that can administer the requirements of the new environmental laws (South Africa. DEA, 2010a; HSRC, 2009).

Despite the emergence of this occupation, very little coherent information exists on the emergence of environmental sciences as a discipline in South Africa. This may be attributed to its 'newness' and the field may therefore lack the reflexivity of longer term emergence. The discussion below tries to illustrate some of the historicity of this discipline through locating it within the broader field of science in South Africa and then explores its relatively recent emergence as a discipline.

8.2.3 Understanding environmental sciences within the broader field of science in South Africa

This section outlines the context and emergence of environmental science in South Africa within the broader disciplinary field of science. There are three professionally constituted organisations providing for the certification and overseeing of scientists:

- Environmental Assessment Practitioners of South Africa (EAPSA);
- South African Council for Natural Scientific Professions (SACNASP); and
- South African Institute of Ecologists and Environmental Scientists (SAIE&ES).

Two of these professionally constituted organisations are voluntary and do not have legal status. EAPSA is a newly formed association for environmental assessment practitioners still awaiting approval from the Minister of Environment; no significant data was available. SAIE&ES is a recognised voluntary association within SACNASP. I will therefore concentrate my discussion on the only legal entity representing scientists in South Africa, which is SACNASP.

SACNASP is the legislated regulatory body for natural scientists in South Africa. It was legislated into being in August 2003 by the Natural Scientific Professions Act, 2003 (Act No. 27 of 2003). This Act legislates the compulsory registration of all natural scientists in South Africa. A single act covering the broad field of natural science is itself a difficulty and the Act is often referred to as an 'enabling act' as it represents a 'federation of persons who practice in specific fields' (South African Council for Natural Scientific Professions [SACNASP], 2012a; SACNASP, 2012b).

A key function of SACNASP is the registration of all natural scientists. Registration of scientists is viewed as an **essential means to professional status, recognition by peers, strengthening of the profession and to ensure that the public is protected by receiving quality service**. The Act makes it mandatory for any person working in a scientific consulting capacity to be a registered scientist; this is, however, not enforced. Schedule 1 of the Natural Scientific Professions Act, 2003 (Act No. 27 of 2003) recognises eighteen fields of practice within natural sciences. The currently defined fields of practice are outlined in the table below:

Table 8.1: Fields of practice of natural science in South Africa

Fields of practice: Schedule I of the Act	
Agricultural Science	Includes Forestry Science
Animal Science	
Aquatic Science	Includes Marine Science
Biological Science	
Botanical Science	
Chemical Science	Includes Industrial Science
Earth Science	Includes Geographical Science, GIS Science, Hydrological Science
Ecological Science	
Environmental Science	
Food Science	
Geological Science	
Materials Science	Includes Metallurgical Science
Mathematical Science	
Microbiological Science	
Physical Science	Includes Radiation Science
Soil Science	
Water Resources Science	Includes Hydrological Science and Water Science
Zoological Science	

(Retrieved from SACNASP, 2012a; SACNASP, n.d.)

Each discipline within SACNASP is managed by a Professional Advisory Committee, which is drawn from sector specialists. They have the task of providing expert specialist input and are key within the processes of reviewing applications for registration.

8.2.4 Understanding the profile of natural scientists in South Africa

In the absence of coherent information on environmental sciences as a discipline, I developed a profile of the discipline using mainly SACNASP data as it seemed to provide the most coherent picture. Data available from 2006 to 2012 reflected that there is an increasing cohort of scientists registering as depicted in Table 8.2 below.

Table 8.2: SACNASP numbers of scientist from 30 April 2006 - 30 April 2012

	2006	2007	2008	2009	2010	2011	2012
Candidate	170	145	158	174	179	220	310
Certified	58	78	103	108	107	151	288
Professional	2966	3180	3380	3549	3655	3867	4340
Total	3194	3403	3641	3831	3941	4238	4938
Annual increase	217	209	238	190	110	297	700

(Source: SACNASP, 2012a; SACNASP, 2012b)

Although the registered figures above look positive as they are increasing, the SACNASP October 2012 report to parliament (SACNASP, 2012a) noted that there were still large numbers of scientists who are believed not to be registered. SACNASP management suggests that around 50% of South Africa's scientists still remain unregistered (SACNASP, 2012b, In 20).

A further indication of the profile of scientists can be provided by examining the distribution of scientists across fields of practice, which reflects as follows:

- 28% Geological Science
- 11% Earth Science
- **10% Environmental Science**
- 8% Agricultural Science
- 8% Animal Science
- 7% Chemical Science
- 4% Ecological Science

(SACNASP, 2012b)

The SACNASP president reported in parliament that the reflected "10% for environmental science was too low, it was important to clamp down on how this discipline was practiced as there were many problems in the field" (SACNASP 2012b). Further demographic information on the scientist cohort reflects that 36% are in the 50+ years cohort. A very positive indication is the increase in numbers from 24% in 2006 to 30% in 2012 in the 30-39 years cohort (SACNASP, 2012b).

The gender distribution reflects a very uneven pattern with males making up 82% of the cohort in 2006. In 2012 the gender distribution reflected 73% male and 27% female (SACNASP, 2012b), showing an increase in female scientists, but from a low base of female scientists.

An important observation within the SACNASP characterisation is that fields like botany, zoology, ecology are listed and regarded as separate from environmental sciences. These are typically routes into the environmental sciences, and are regarded in field-based practice as specialisations within environmental sciences. This is significant to a study on pathways, as these routes are commonly seen as possible access routes into an environmental sciences career.

8.2.4.1 Understanding SACNASP registration

As this section has relied on SACNASP as a key legal entity, it seems important to understand how a person can become accredited by SACNASP. According to the Act, scientists are registered in the following categories;

- Certificated Natural Scientist (Cert.Nat.Sci.)
- Candidate Natural Scientist (Cand.Nat.Sci.)
- Professional Natural Scientist (Pr.Sci.Nat.)

All categories require applicants to submit detailed work experience records as well as academic records. Academic records need to display in first year 70% natural science content; 80% natural science context in second and third year and 100% content in fourth/honours year. The balance can come from relevant proficiency skills and business (SACNASP, 2012b). This rule means that environmental science scholars are forced into doing 'pure' sciences such as physics, chemistry, zoology, botany alongside their environmental science; an environmental science and geography combination or an environmental science / social science combination would, for example, not be acceptable.

A significant challenge to a study on learning pathways is that at present several widely used degrees offered in the environmental sciences in South Africa are not applicable for registration with SACNASP. Inability to register with SACNASP potentially creates a serious barrier in the work transitions of environmental scientists (as is illuminated by the career stories that follow in this chapter, see section 8.3). Some of the environmental science related postgraduate degrees that are not recognised by SACNASP are:

- Masters degree in Environmental Management
- Masters degree in Sustainable Agriculture; Livestock Production, etc.
- Masters in Environmental Law
- M.Phil. or M. Agric. degrees, e.g. Wildlife Management. (SACNASP, 2012a)

Table 8.3: Other listed degrees oriented to the environmental sciences not recognised by SACNASP

Type of degree	Field of study	
BA	Social Geography Social Sciences Environmental Management	The subjects listed in this table all reflect specialisations available and subjects that could potentially form part of subject selection within environmental science qualifications BUT they are not recognised by the SACNASP.
BSc/BSc Honours	Community Water Services and Sanitation Environmental Management Environmental Technology Geography and Informatics Geography and Environmental Management Hydrology and Water Resource Management Landscape Architecture Water Resource Management Water Utilisation	

(SACNASP, 2012a, p. 11)

This discussion has helped to clarify the broader official positioning of environmental sciences within the professional accreditation sphere. The discussion on what is accredited and what is not clarifies and provides a frame for understanding the possibilities for an individual to become registered as an environmental scientist. In the section below I explore more carefully the emergence of environmental sciences as a discipline.

8.2.5 Understanding the emergence of environmental sciences

Snowman, Fuggle and Preston (1995) have provided the most coherent narrative on the emergence of environmental assessment practices in South Africa. They reflected that the Habitat Council, a non-governmental organisation established in 1974, provided some of the first recorded discussions on Environmental Impact Assessments (EIAs) and ideas on how development should provide environmental impact surveys. This framed the agenda for government lobbying for better environmental planning in the 1970s. Thus, during the 1980s the voluntary undertaking of EIAs within development planning and decision-making began to receive widespread support. They outlined how these processes culminated in the publication of Integrated Environmental Management procedural documents and the Environmental Conservation Act in 1989.

The development of environmental sciences in South Africa has had a short but rapid history. The only indication of when it started to be viewed as an independent discipline is perhaps the start of the different faculties in South African universities. Website searches revealed that Environmental Sciences was established at Rhodes University in 1998 and at University of Venda in 1995 (I was unable to get clear dates for University of Pretoria, University of Johannesburg or University of the North West). This seemed to indicate that environmental sciences emerged as a separate field of study or specialism in the mid-1990s in South African universities.

Although only interested in natural scientists, SACNASP (n.d.) defined environmental sciences as a “multi-disciplinary science concerned with the relationship between elements of the natural environment and the interaction between man [sic] and the environment in which emphasis is placed on the interrelationships between elements of the ecosystem”. Shackleton et al. (2011) also highlighted that the rapidly changing nature of environmental sciences is evident in a broad range of applied fields as well as the emerging environmental fields which integrate across traditionally separate sciences (such as sustainability sciences, resilience science, social science, environmental justice and governance, environmental modelling and scenario development, and environmental economics). This shows that the emergence of environmental sciences in South Africa is not significantly different to the UK experience discussed above and reflected in Figure 8.1.

The introduction to environmental sciences provided by SACNASP recognises that environmental science as a discipline includes both social and natural science but SACNASP confines itself to natural sciences only (SACNASP, n.d.). Thus to register as an environmental scientist, candidates are required to meet all the entry requirements that were outlined in section 8.2.4.1., which means that their subject selection needs to have sufficient amounts of ‘pure’ natural science. In addition, the environmental science professional registration requires that candidates complete courses in environmental management, environmental impact assessment, environmental law and environmental auditing (SACNASP, n.d.; Int 20)

8.2.5.1 The emerging demand

Environmental scientists have been identified as a scarce skill by the Department of Environmental Affairs (South Africa. DEA, 2010) and in a report by GreenMatter (2012). These national research reports highlighted a need for environmental scientists both in terms of numbers and the need to promote young entrants. Environmental scientists as a scarce skill has been repeatedly experienced by CATHSSETA (which is the sector skills authority within which the conservation

chamber is found) (In10). The research manager of CATHSSETA also reported that though environmental scientists were continuously featuring as a scarce skill, they were unable to pinpoint what the exact skill need was as there appeared to be a very varied and imprecise view of this skill (In10). A further indicator of environmental science demand is that the environmental scientist continues to feature as a scarce skill in the following 2013-2014 Sector Skills Plans: Energy and Water SETA, Local Government SETA, Agriculture SETA, CATHSSETA, and the Mining Qualifications Authority.

The Strategic Infrastructure Programme of national government also lists environmental managers as an immediate scarce skill with a short-term need of 150 persons (South Africa. DHET, 2013b).

This table below extracted from the Environmental Sector Skills Plan (South Africa. DEA, 2010a) provides further evidence of the demand for science professionals within the environmental sector.

Table 8.4: Vacancy data on science related occupations (South Africa. DEA, 2010a)

HR Vacancy Data Related to Critical Occupations in the Public Sector (as of March 2008)	Number of posts	Number of posts filled	Vacancy rate
Agriculture, Animal, Oceanography, Forestry & other sciences, Permanent	1415	974	31.2
Biochemistry, Pharmacology, Zoology & Life Science technical, Permanent	1517	1110	26.8
Biologists, Botanists, Zoologists & related professionals, Permanent	137	103	24.8
Natural Sciences related, Permanent	853	538	36.9
Nature Conservation and Oceanographical related technical, Permanent	910	441	51.5
Chemical and Physical Science technicians, Permanent	84	60	28.6
Geologists, Geophysicists, Hydrologists and related professions, Permanent	426	205	51.9
Meteorologists, Statistical & related technicians, Permanent	43	8	38.5

This demand is further emphasised by the CATHSSETA Conservation Chamber Guide (2013), which reflects both potential and current vacancies in the following occupations:

- Environmental science technician
- Park ranger
- Environmental scientist
- Conservation scientist
- Animal behaviourist
- Environmental manager.

The discussion above has provided an orientation to the nature of environmental sciences and its official designation within the sciences in South Africa. The next section will explore the key supply platforms for environmental sciences.

The discussion below will elaborate on the key supply systems that support the learning pathways of environmental scientists.

8.3 Understanding the institutional pathways of environmental scientists

Drawing again on the institutions supporting educational and occupational progression, I have tried to investigate the institutional structures supporting transitions of students within the environmental science occupation. As the data collection and research unfolded, it was difficult to separate the environmental scientist from the environmental manager. For example, when I contacted firms to request meetings with their environmental scientist, I was referred to the environmental manager (who often had an environmental science degree). Hence as the chapter unfolds, I have presented data gathered from both environmental managers as well as environmental scientists.

I will begin by looking at the characterisation of the occupation and then examine the qualifications available and the existing skills planning mechanisms.

8.3.1 Understanding the profile of this occupation from the workplace/employer perspective

Data in this section was drawn from interviews and my participatory observations in the environmental manager working group. In the Strategic Infrastructure Programme (SIPs) occupational task teams within which I participated, we engaged in extensive discussion on the service provided by this occupation, how this occupation is differentiated in the field and its scope. Often this occupation is understood and discussed entirely as an Environmental Assessment Practitioner (EAP) role,

... majority of environmental jobs fall outside this limited scope. In the construction setting these jobs are predominantly involved in activities that follow the initial impact assessment

and include preparations of environmental management plans, setting up and maintaining environmental management systems, undertaking environmental audits and the delivery of a host of environmental services. (In12)

The extract below (from these discussions and the team Chairperson's report from group feedback) provides an illustration of how the occupation is viewed and differentiated within the workplace and provides an example of the widely used job titles related to this occupation:

- **Environmental Manager (EM)** – manages environmental concerns on behalf of the client/project/organisation at a strategic level through ensuring that the environmental authorisation, licensing, permitting, environmental management plan or system, environmental requirements and specifications are kept up to date, adhered to and relevant to the activities undertaken.
- **Environmental Officer (EO) or also known as an Environmental Site Officer (ESO)** – practically implements the conditions of the environmental management plans, environmental management systems and legislation.
- **Environmental Control Officer (ECO)** – provides an assurance and risk management function for the projects and acts as the interface between the project and government/interested and affected parties. Please note that this definition of an ECO differs from the mining ECO who is responsible for the quality of air, water and thermoregulation in mine shafts and generally has an environmental health qualification.
- **Environmental Assessment Practitioner (EAP)** – undertakes and oversees the Environmental Impact Assessment (EIA) process. An EAP is legally required to be registered with the Environmental Assessment Practitioners Association of South Africa (EAPASA) in order to practice.
- **Environmental Specialist/ Environmental Scientist** – subject matter specialist (e.g. ecologist, botanist, water quality specialist, entomologist, marine biologist, avifaunal specialists, herpetologist, etc.) provides specialist input during the Environmental Impact Assessment (EIA) phase or similar required specialist studies and is legally required to be registered with the South African Council for Natural Scientific Professions (SACNASP) who currently have 8 levels of certification for their qualification and experience criteria. (FN 2; FN14; In12)

My own experience during this research has been that there is considerable generalising around the job title and how the role of environmental scientist is understood (In10; In12, FN14). In the section below I explore how the occupation is represented within the post-school system Organising Framework for Occupations (OFO).

8.3.2 Understanding the profile of this occupation from official occupational categorisation in the Organising Framework for Occupation (OFO)

In the discussion below, I provide an example of how this occupation is presented within the Organising Framework for Occupation (OFO). The transitioning system interest of the study necessitated that I try to understand how the framing of the occupation was changing and how it was shaped within supply systems.

The figure below illustrates how the occupational tasks and roles were framed in the OFO in 2011. This shows that environmental scientist did not exist as an occupation. In 2011 it was regarded as a specialisation of an environmental research scientist. The extract below from the 2011 OFO also helps me to illustrate the job titles that were in use (in 2011) across the three main environmental occupations featured.

234302 Environmental Consultant (Skill Level 5) - Analyses and advises on policy guiding the design, implementation and modification of government or commercial environmental operations and programs. - Alternative Titles and Specialisations: - Energy Efficiency Consultant - Energy Officer - Environmental Advisor - Environmental Analyst
234303 Environmental Research Scientist (Skill Level 5) - 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: - Air Pollution Analyst - Animal Ecologist - Conservancy Advisory Scientist - Ecological Researcher - Ecologist - Environmental Auditor <u>Environmental Scientist</u> - Environmentalist - Land Degradation Analyst - Water Quality Analyst
139902 Environmental Manager (Skill Level 5) - Plans, organises, directs, controls and coordinates the development and implementation of an environmental management system within an organisation by identifying, solving and alleviating environmental issues such as pollution and waste treatment in compliance with environmental legislation and ensures corporate sustainable development. - Alternative Titles and Specialisations: - Agriculture and Forestry Coordinator - Conservation Science Manager - Contaminated Sites Manager - Land Care Manager - Land and Water Manager

Figure 8.2: Framing of environmental science occupation in 2011 (DHET, OFO Version 9)

As explained in section 5.4, the OFO underwent substantial changes. The two tables that follow (Table 8.3 and Table 8.4) illustrate the current 2013-2014 representation of the environmental science and environmental manager occupations in the OFO. It is evident from this data that environmental scientist in the transition has become a designated occupation. The tables below also provide an indication of the types of job titles recognised that are being mapped to this occupation within the OFO. I have again provided both environmental scientist and environmental manager to facilitate understanding of occupational distribution.

Some key observations from the transitions of the OFO are that the environmental consultant has been integrated into the environmental scientist and roles associated with energy efficiency (energy officer; energy efficiency consultant) that were reflected in environmental consultant have been shifted into the new occupation energy efficiency technician (311303), which is located within the group of electrical engineering technicians. Other occupational titles appear to be distributed across two unit groups:

- 2133 Environmental Protection Professionals which contain occupations like Conservation Scientist to which Ecologist and Ecological Researcher are mapped; Environmental Scientist; Earth and Soil Scientist; Air Pollution Analyst; Water Quality Analyst; Park Ranger
- 2131 Life Science Professionals which contain occupations like, Biologist; Physiologist; Biochemist; Biotechnologist; Botanist; Marine Biologist; Microbiologist; Zoologist (South Africa. DHET, 2013c)

It is significant to note that the predominant type of occupational tasks and roles reflected in the OFO of environmental scientist revolve around the environmental assessment practitioner – person who conducts environmental assessments (see tables below). This reflects a difference in how this occupation is differentiated and represented within the OFO system from the occupational task team as discussed in section 8.3.1.

Table 8.5 that follows presents an overview of the OFO for Environmental Scientist and Table 8.6 presents the overview of OFO for Environmental Manager (South Africa. DHET,2013c)

1. 213302 Environmental Scientist		Table 8.5
MAJOR GROUP	2 Professionals	
SUB-MAJOR GROUP	21 Physical Mathematical and Engineering Science Professionals	
MINOR GROUP	213 Life Science Professionals	
UNIT GROUP	2133 Environmental Protection Professionals Environmental protection professionals study and assess the effects on the environment of human activity such as air, water and noise pollution, soil contamination, climate change, toxic waste and depletion and degradation of natural resources. They develop plans and solutions to protect, conserve, restore, minimize and prevent further damage to the environment	Tasks include: Conducting research, performing tests, collecting samples, performing field and laboratory analysis to identify sources of environmental problems and recommending ways to prevent, control and remediate the impact of environmental problems; Assessing the likely impact that potential or proposed activities, projects and developments may have on the environment, and recommending whether such developments should proceed Developing and coordinating the implementation of environmental management systems to enable organizations to identify, monitor and control the impact of their activities, products and services on the environment; Conducting audits to evaluate environmental impact of existing activities, processes, wastes, noises and substances; Assessing an organization's compliance with government and internal environmental regulations and guidelines, identifying violations and determining appropriate remedial action; Providing technical advice and support services to organizations on how best to deal with environmental problems in order to reduce environmental damage and minimize financial loss; Developing conservation plans
OCCUPATION	213302 Environmental Scientist 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

2. 134901 Environmental Manager		Table 8.6
MAJOR GROUP	1 Managers	
SUB-MAJOR GROUP	13 Production and Specialised Services managers	
MINOR GROUP	134 Professional Services Managers	
UNIT GROUP	1349 Professional services managers not classified elsewhere This unit group covers managers who plan, direct coordinate and evaluate the provision of specialised professional and technical services and are not classified in sub-major group 12, business services and administration managers, or elsewhere in sub-major group 13, professional services managers. For instance, managers responsible for the provision of policing, corrective, library, legal and fire services are classified here.	Tasks include: Controlling administrative operations such as budget planning, report preparation, expenditure on supplies, equipment and services; Coordinating cooperation with other service provision agencies in the same or related fields; Developing, implementing and monitoring procedures, policies and standards for staff; Directing, supervising and evaluating the work activities of professional technical, clerical, service, maintenance, and other personnel; Managing budgets, controlling expenditure and ensuring the efficient use of resources ; Monitoring and evaluating resources devoted to the provision of services; Overseeing the selection, training and performance of staff; Planning, directing and coordinating the provision of services
OCCUPATION	134901 Environmental Manager Plans, organises, directs, controls and coordinates the development and implementation of an environmental management system within an organisation by identifying, solving and alleviating environmental issues such as pollution and waste treatment in compliance with environmental legislation and ensures corporate sustainable development.	Alternative Titles and Specialisations: Agriculture and Forestry Coordinator Centralised Permits and Cites Manager Conservation Science Manager Contaminated Sites Manager Environmental Education Manager Land and Water Manager Land Care Manager Pollution and Waste Group Manager Species Protection Manager Wild Life Management Services Manager Wild Life Protection Services Manager Conservation Agriculture System Manager

This section has presented some insights into how the understanding of this occupation is in transition both within official platforms (like OFO) as well as within employer perspectives. This is similar to the UK observation that, even after 50 years, there are inconsistent understandings of the environmental science discipline especially from employers. In the next section, I explore broadly the skill planning dimensions emerging in the provisioning of this occupation.

8.3.3 Skills planning for this occupation

The discussion below reflects experiences of workplace skills planning related to this occupation. The complexities of environmental science being cross-sectoral was clearly illustrated by discussions in the Human Resource Development Network (FN 11; FN 13; FN15). Conservation organisations seem to be dispersed across SETAs (see below), but found that their skills development needs were not being adequately addressed (as discussed below). The following examples emerged in workshop discussions: the Plastics Federation (one of the employers in the HRD Network) is registered with ETDP SETA but has to work closely with Manufacturing, Engineering and Related Services SETA; Ezemvelo KZN Wildlife (provincial conservation authority) is registered with CATHSSETA but has had to form an association with SASSETA (the Security SETA). The South African National Biodiversity Institute is registered with CATHSSETA; however, learning programme provision in CATHSETA does not respond to some of their critical skill needs, for example, horticulture and professional scientists. They are therefore considering re-registration with AgriSETA (FN 11; FN 13; FN15; WWF, HRD Toolkit n.d.). These dynamics help to illustrate some of the challenges with workplace skills planning faced by these conservation organisations.

Data in one interview (In10) and CATHSETA (2013) both outlined that the underlining issue with filling environmental scientist vacancies lies in the technical and normative demands of employers who in principle need an MSc to employ an environmental scientist but at the same time bemoan that graduates lack the 'correct specialisation' (In10; In16).

A further complexity related to skills planning is related to the career pathing of environmental scientists within organisations. The example below in Figure 8.3 illustrates career pathing for environmental scientists and technicians in a provincial conservation organisation.

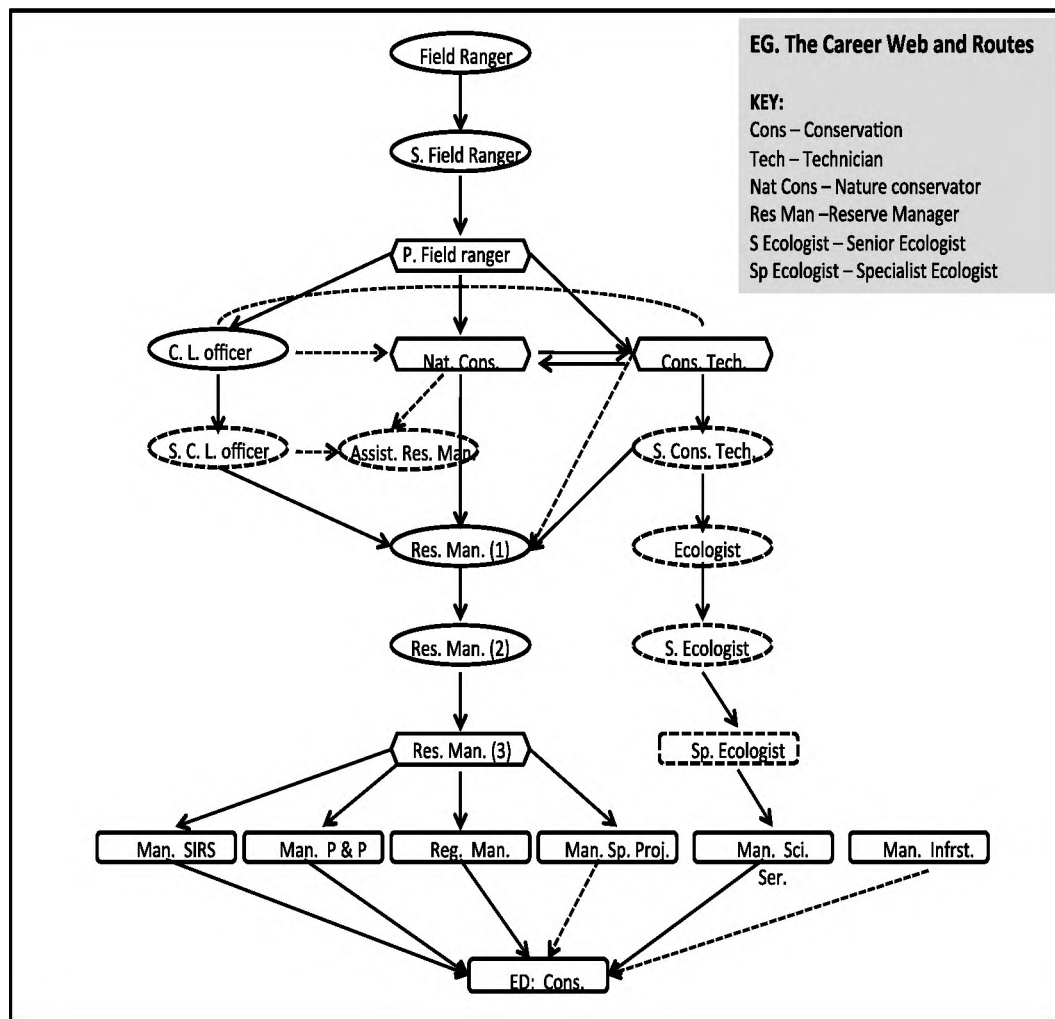


Figure 8.3: Extract from a provincial conservation agency career routes organogram (Source: Career Webs from provincial conservation authority)

The extract illustrates that within the conservation context of this organisation it is envisaged that a conservation technician could transition into ecologist then senior and specialist ecologists. In this organisation, the minimum entry requirement for an ecologist was reflected as an MSc (In12). This suggests that it is nearly impossible for technicians to transition further than senior technician within this context, if a technician is employed with National Diploma.

To further support this type of career progression, evidence from workshop discussions (FN 11, FN 13) suggested that many technicians are employed with BSc Honours and are then supported by organisations to get an MSc so they can transition into scientist positions. This evidence of ‘under-employing’ was further highlighted in employer interviews (In 11) and the career stories. For example, ES3 reflected that she started with a salary of R6000 (less than a teacher with a four-year

degree) after obtaining her MSc and studying for seven years. The interview of a national conservation employer reflected the following:

... most of the applications we get are undergraduate, not experienced, and I am the first one to understand that you start somewhere, but competing with people who have MSc degrees. If we are picking between a MSc student and a Honours student there is not a huge pool but there are always applicants with postgraduate [qualifications] so we prioritise them for their research skills. (In 11)

This is setting up the expectation of an MSc being the entry qualification for entry into the environmental sciences. Furthermore, there is no indication of a parallel pathway or opportunities for second chance pathing for environmental sciences as reflected in data presented below in Figure 8.4 and Table 8.4. Both reflect a dominant single route academic pathway.

8.3.4 Qualifications

The first layer of analysis for the environmental science sub-field was to ascertain the distribution of qualifications across NQF levels. A total of 111 environmental qualifications are registered as part of the environmental sciences sub-field within National Learner Record Database (NLRD). Environmental sciences qualifications constitute around 12.4% of all (896) environmental/sustainable development related qualifications registered on the NQF (as reflected in Chapter 5). A trend similar to the broad analysis of all environmental qualifications on the NQF was established where fewer qualifications are registered at lower NQF levels with most qualifications (73.9%) being located at postgraduate levels (levels 8-10). This affirms the earlier mentioned postgraduate entry route into the sector (see discussion in section 8.1.3). About 14 qualifications have not yet been assigned levels on the new NQF but pre-2009, these belonged to levels 5 to 7.

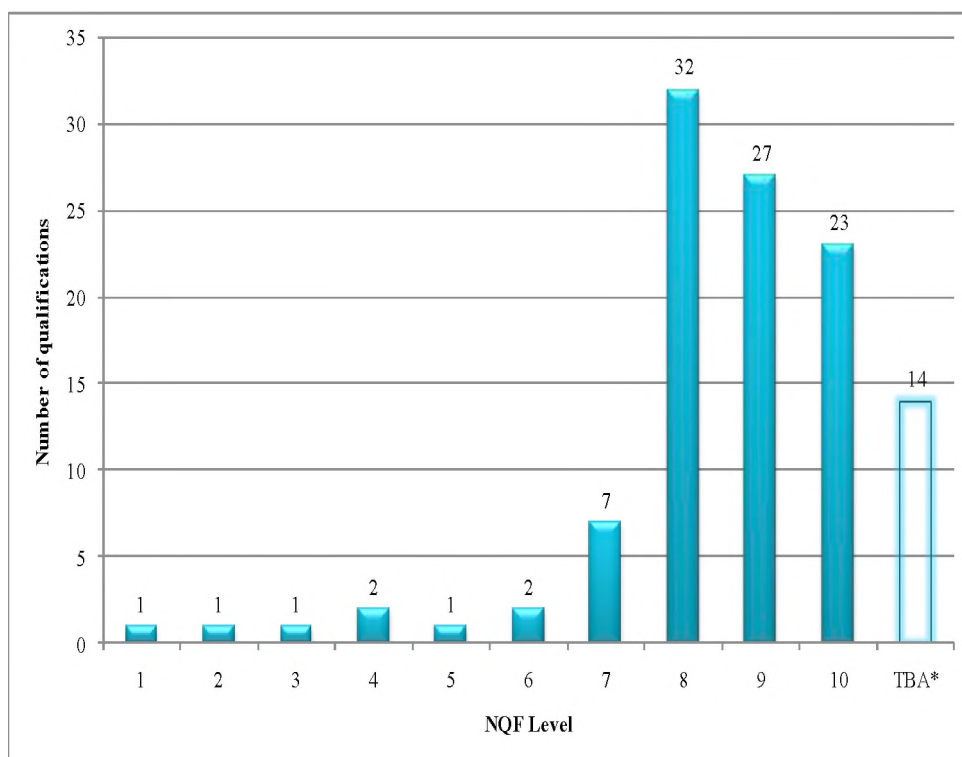


Figure 8.4: The distribution of environment/sustainable development qualifications in the environmental sciences sub-field

This illustrates that the dominant entry point into environmental sciences is through a postgraduate qualification. This invariably begins to restructure the labour market as noted by Cedefop,

Qualifications are important in modern societies as carriers of information and value (currencies), extensively influencing the way occupations and professions are defined and regulated. By defining the minimum level of knowledge, skills and competence required by somebody holding a particular position, qualifications regulate access to, and conduct of, an occupation or profession. (2013, p. 50)

Data collected in this study and from the Environmental Sector Skills Plan (South Africa. DEA, 2010a) show that the sector is employing highly qualified personnel (with honours and masters degrees, and that the more specialised areas such as air quality and marine and coastal zone management, appear to require masters level qualifications). Interview data from career stories (see section 8.4 below) reflects a very strong focus on postgraduate qualifications. All interviewed candidates possessed postgraduate qualifications and most remained at university to complete postgraduate studies before entering the workplace. This seems to suggest that the high skill entry point is reinforced from employer perspectives (In11; In12; In18) and corroborates the Cedefop (2013) assertion that qualifications also evolve to play a gatekeeping function in occupations.

A further dimension of the qualifications discussion relevant to this occupation is illustrated in the table below. I explored the actual qualifications allotted to the environmental science sub-field within the NLRD database and show their distribution in the table.

Table 8.7: Environmental science qualification titles

NQF Level	Qualification Title	Total
Level TBA: was L5 pre-2009	Certificate: Environmental Management	1
	Certificate: Geographical Information System	1
	Certificate: Remote Sensing	1
	National Certificate: Environmental Noise Control	1
	National Certificate: Weather Observation	1
Level TBA: was L5 pre-2009 Total		5
Level TBA: was L6 pre-2009	Bachelor of Science: Applied Environmental Sciences	1
	Bachelor of Science: Ecological Sciences	1
	Bachelor of Science: Environmental Science	1
	Bachelor of Science: Geography and Environmental Management	1
	National Diploma: Maritime Studies	1
Level TBA: was L6 pre-2009 Total		5
Level TBA: was L7 pre-2009	Bachelor of Technology: Environmental Management	3
	National Certificate: Environmental Assessment Practice	1
Level TBA: was L7 pre-2009 Total		4
NQF Level 01	General Education and Training Certificate: Environmental Practice	1
NQF Level 01 Total		1
NQF Level 02	National Certificate: Environmental Practice	1
NQF Level 02 Total		1
NQF Level 03	National Certificate: Environmental Practice	1
NQF Level 03 Total		1
NQF Level 04	Further Education and Training Certificate: Environmental Noise Practice	1
	Further Education and Training Certificate: Environmental Practice	1
NQF Level 04 Total		2
NQF Level 05	National Certificate: Environmental Management	1
NQF Level 05 Total		1

NQF Level	Qualification Title	Total
NQF Level 06	National Diploma: Maritime Studies	2
NQF Level 06 Total		2
NQF Level 07	Bachelor of Arts: Geographical and Environmental Science	1
	Bachelor of Science: Biodiversity and Conservation	1
	Bachelor of Science: Botany	1
	Bachelor of Science: Environmental Management	1
	Bachelor of Science: Environmental Science	1
	Bachelor of Science: Environmental Sciences	2
NQF Level 07 Total		7
NQF Level 08	Bachelor of Earth Sciences: Geologic: Hydrologic and Meteorologic Studies	1
	Bachelor of Environmental Management Honours	1
	Bachelor of Environmental Sciences Honours: Ecology and Resource Management	1
	Bachelor of Environmental Technology	1
	Bachelor of Science Honours	1
	Bachelor of Science Honours: Applied Environmental Sciences	2
	Bachelor of Science Honours: Archaeology	1
	Bachelor of Science Honours: Archaeology and Environmental Science	1
	Bachelor of Science Honours: Botany	6
	Bachelor of Science Honours: Ecology	1
	Bachelor of Science Honours: Ecology and Conservation Biology	2
	Bachelor of Science Honours: Entomology	1
	Bachelor of Science Honours: Environment and Water Science	1
	Bachelor of Science Honours: Environmental and Geographical Science	1
	Bachelor of Science Honours: Environmental Microbiology	2
	Bachelor of Science Honours: Environmental Science	2
	Bachelor of Science Honours: Ethnobotany	2
	Bachelor of Science Honours: Geography: Environmental Analysis and Management	1
	Bachelor of Science Honours: Zoology	3
	Postgraduate Diploma: Land Tenure and Land	1

NQF Level	Qualification Title	Total
	Use Systems	
NQF Level 08 Total		32
NQF Level 09	Master of Philosophy: Environmental Geochemistry	1
	Master of Philosophy: Environmental Science	1
	Master of Science: Biochemistry	1
	Master of Science: Biological Systematics	2
	Master of Science: Botany	5
	Master of Science: Entomology	1
	Master of Science: Environmental Science	2
	Master of Science: Environment and Society	1
	Master of Science: Environment and Water Science	1
	Master of Science: Environmental and Geographical Science: Research	1
	Master of Science: Environmental Ecology	1
	Master of Science: Environmental Economics	1
	Master of Science: Environmental Education	1
	Master of Science: Environmental Geochemistry	1
	Master of Science: Environmental Science	1
	Master of Science: Human Movement Science	1
	Master of Science: Microbiology	1
	Master of Science: Water Resources Management	1
	Master of Science: Zoology	3
NQF Level 09 Total		27
NQF Level 10	Doctor of Literature: Geography	1
	Doctor of Philosophy: Anthropology	1
	Doctor of Philosophy: Applied Mathematics	1
	Doctor of Philosophy: Biodiversity and Conservation Biology	1
	Doctor of Philosophy: Botany	6
	Doctor of Philosophy: Entomology	1
	Doctor of Philosophy: Environmental and Geographical Science	1
	Doctor of Philosophy: Environmental Management	1
	Doctor of Philosophy: Environmental Sciences: Management	1
	Doctor of Philosophy: Environmental Studies	1
	Doctor of Philosophy: Hydrological Sciences	1
	Doctor of Philosophy: Microbiology	1

NQF Level	Qualification Title	Total
	Doctor of Philosophy: Physics	1
	Doctor of Philosophy: Zoology	3
	Doctor of Psychology	1
	Doctor of Science: Geography	1
NQF Level 10 Total		23
Grand Total		111

(Note on shaded areas: as South Africa is in the transition from an eight level to a ten level NQF, some qualification levels are still pending; hence the pre-2009 indication shown; these are qualifications which were running but are awaiting new level allocations at the time of data analysis)

The data in the table above illustrates the clear science based academic focus of the discipline. While this is clearly important and necessary, there is no current evidence of emergence of socio-ecologically related degrees. It re-emphasises the postgraduate science access points and clearly illustrates the lack of qualification in the technical and vocational spaces. The reflected environmental practices vocational qualification was not being effectively utilised and did not currently offer viable access routes into the sector (South Africa. DEA, 2010a). The discussion in this section has reflected on the institutional pathway for environmental scientists and provided evidence of the clear single pathway academic route.

8.4 Understanding the learning and work transitions over the life course of environmental scientists

Understanding the transitional processes and outcomes are significant in deconstructing the mechanisms that shape the crafting of a career in the environmental sector. In the discussion below I outline experiences during key educational transitions across the career stories that I constructed for this occupation. The focus across the career story was educational progression into an environmental science job. These stories have tried to reflect both the processes and outcomes of transitions.

The evidence from career stories (interview data and CVs) is outlined and where necessary I have tried to provide 'thick descriptions' to support my discussions. I start with brief maps of each of the seven respondent's life course learning pathways into environmental sciences before discussing them within the life course framework.

Table 8.8: Environment life course learning pathways

Ref	Demographic	Comment
ES 1	White male	Attempted a BSc but his school physics was too weak and he struggled. He swapped into a BA Geography and Environmental Studies. Completed Honours in Geography and Environmental Management but failed to complete a master's degree. He started work within a small consultancy and developed a wetland interest and specialisation and developed skills in bio monitoring. He moved on to a large environmental company and progressed onto wetland divisional manager. He left as he started feeling his scientific technical skills were letting him down. He moved onto a smaller consultancy where he transitioned to working more in an environmental manager role. He subsequently moved on to a large environmental consulting agency as a project manager and is currently involved in managing large projects across Africa.
ES2	White Female	Good base of math, science and biology at school, which she found very helpful at university. She did a BSc Geology and Earth Science. Her focus was on geology and only developed an insight into environmental science during her honours year. Worked part-time during her MSc at large engineering company within the environmental division. She joined an environmental consulting firm and worked as an environmental manager.
ES3	White Female	Attended a private school, she went on to do a BSc with majors in Biochemistry and Zoology. She transitioned straight into honours in Aquatic sciences and then into masters in aquatic toxicology. Started working in a consulting company during her master's year, which gave her exposure to mining companies across Africa. It was a very challenging transition as they were thrown into projects and required high level project management skills. Post masters she was employed as a research assistant in environmental firm. She then joined a large global financial consulting firm as an environmental consultant.
ES4	White Male	Grew up on a smallholding. Didn't do geography or biology at school. Entered a BSc with majors in zoology and botany. In his final year he went on a Botany tour to Cape and this stimulated his career interest in Botany. He transitioned straight into honours and then masters in Botany. During masters taught science at a school. Joined Department of Agriculture as pasture research officer. This formed the basis of his PhD. He transitioned into conservation department and

Ref	Demographic	Comment
		was absorbed into Environmental Affairs post apartheid as an environmental policy specialist. He left to work as an independent consultant and is now an environmental manager within a large engineering company.
ES5	White Female	Geography was her favourite subject at school. Did a BA with a major in geography. She progressed into Honours in geography because she thoroughly enjoyed geography. During her honours she heard about the possibility of working as an environmental consultant. She started worked as an environmental consultant at Cleanstream and then joined an environmental consulting firm as a junior environmental scientist. She currently can't progress to senior environmental scientist as she is unable to register as an environmental scientist.
ES6	Black Female	Went to rural school in Limpopo. Understanding living things has always been her interest. She entered university but needed to do an extra year of academic support to improve her science and maths. She thereafter entered a BSc in Community Water and Sanitation Services. She was unemployed for one year and worked as a cashier at Postnet. She started honours in environmental management through correspondence. She then entered a graduate trainee programme for water and sanitation led by an engineering council. She worked as an industrial technician within Department of Water Affairs. She then entered a three-year programme for young professionals. After this programme she was unemployed for a year. She thereafter was employed as a junior environmental project manager for five months from which she was retrenched. She was unemployed again for eight months and entered a job as environmental technician at a municipality.
ES7	Black Male	Keen interest in geography and science in school. After his geography major degree was disrupted by boycotts he opted to complete a degree by correspondence. He was unable to continue with geography as the practicals were about 700km away from his home. He thus opted for a BSc Environmental Science degree. While doing his degree, he worked as a part-time Science teacher. After his degree he worked in a social welfare organisation as an administrator. Thorough perseverance he entered Eskom as corporate officer in their environmental management division. He then moved into a senior environmental officer position. He went on an exchange programme for environmental leaders to the USA. He formed a link with UNEP and has been involved in 35 UNEP

Ref	Demographic	Comment
		programmes as well as Global Environmental Outlook reports 1-3. He is currently a senior environmental manager within the electricity utility. He is currently involved in a PhD with a climate change focus.
ES8	Black Male	Grew up with parents who were very keen gardeners and has grown up with a love for plants. He entered a BSc Botany and Zoology. On completion he needed to work so he didn't move straight into postgrad. Was unable to secure a job as a black scientist so went to teach at school. He applied for a lab assistant post, which he didn't get, but the professor gave him very good career advice and help. He then started as a nature conservator within a reserve based at a university and worked part-time as a lab assistant within the Botany department. He left his family and travelled to work as a senior laboratory assistant in zoology in a rural university. He spent six years away from home working as senior lab assistant and completed an honours degree. He returned home to work as a scientific officer in the herbarium within a botanical garden. Here he realised after three years that to work in research he needed to complete his qualifications and proceeded to complete an MSc in and subsequently a PhD. He moved from being a scientific officer to a scientist and eventually to chief scientist within the herbarium.
ES9	White Female	She entered university to do a B Social Sciences in Economics and Psychology. She did honours in Economics. Her dad was a lecturer at UCT so she was able to spend six years there due to low fees experimenting with courses. She entered an NGO as a researcher and was involved in local government research. She did a computer-programming diploma and transitioned into private sector work within a computer company. She entered a course work masters in GIS and started part-time work at the CSIR. The GIS work was not interesting for her and she changed her masters focus to Industrial and Economic Geography and started working with industrial policy research. She later entered an MBA full-time and really loved it. She started work at an international conservation agency coordinating spatial biodiversity plans for the Succulent Karoo Ecosystem Programme. She started work with Botanical Society and then moved to SANBI. She currently works as a director for biodiversity policy.

8.4.1 Understanding the experiences of transitioning within schooling

As reflected in Chapter 6, the school transitions followed fairly normative transition through schooling into higher education. Some key aspects that emerged are reflected below. In terms of school subject selection interviewees reflected both a science stream and a social science stream. ES1 reflected on having done both history and geography and felt that both gave him a good perspective of “how the world works and where the problems are and to understand how to solve people’s problems” which was similar to the views of ES5 and ES6 who reflected she was “curious about living things”. ES8 reflected extensively on the role of her enthusiastic Biology teacher and the opportunity for microscope work and experiments. Reflecting further on subjects, several suggested a struggle with maths and science: ES1 stated maths and science wasn’t good “I just didn’t get it” and dropped his grades as is similarly reflected by ES 6. ES 5 did not do science at school.

Reflecting on career guidance received at school, interviewees reflected that guidance was about whether you could go to university or not (ES1) and further that if you liked outdoors stuff, you could become a game ranger. Hence none reported strong career guidance as an enabler within their pathway.

8.4.2 Understanding the experiences of transitioning within undergraduate study

All interviewees transitioned successfully into university except ES6 who entered an academic support programme for building competence for science skills. The data reflects that these environmental scientists entered through different tracks. ES1 and ES5 entered via a Bachelor of Social Sciences with a Geography major. ES1 reflected further that his standard grade maths and science did not enable him to cope with university science; he tried for a short period and switched to the social sciences. ES9 transitioned into a Bachelor of Social Sciences majoring in Economics and Psychology. Her story reflected extended transitioning (six years) due to reduced fees (father worked at university), which enabled her to complete another major in economic history. ES7 transitioned into a correspondence BSc Environmental Science degree that reflected a mixture of social and natural sciences. He reflected “there was an option: either you do the science or the social science stream and I chose the mixture of both because of a lack of guidance” (ES7). The remaining interviewees transitioned into BSc with traditional science majors like zoology, botany and biochemistry. All reflected that subject choices were based essentially on what they enjoyed. Several interviewees commented on the fact that they had done many courses but felt that there wasn’t a clear direction that they were moving in. ES6 reflected “the

degree was too scattered; it had a lot of modules that were covered but it did not have core modules so that it can direct one in the direction you anticipate to specialise in" (ES6).

During their undergraduate training, there was very little reflected evidence of understanding environmental careers. ES1 reflected "during honours was the first time I realised that there was a career in environmental management because up until that time I didn't know what career I was going to go into everything was very theoretical". ES3 further reflected that "I don't feel that during my studies at X with the exception of the short course that I did in the geography department that there was any guidance as how to go about our careers". None of the interviewees expressed a clear rational plan about entering an environmental career. Even ES1 and ES7 who did some environmental courses reflected that there were no clear environmental careers that they were contemplating.

None of the interviewees reflected receiving funding during their undergraduate degrees; they were all funded by their families during their undergraduate degrees.

None reflected on being given opportunities for vacation work during their undergrad; their work experiences reflected jobs in tutoring or part-time teaching.

8.4.3 Understanding the experiences of transitioning within postgraduate

Except ES7, ES8 and ES9, all others transitioned directly into postgraduate studies. A key enabler was access to funding, as reflected by ES1, ES3, ES4 and ES5. They all entered honours degrees that were university funded projects.

ES2, who chose honours in geology, struggled to get funding, as her focus was sedimentology. She reflected that her colleagues that were focused on mining related geology research had an abundance of funding (ES2).

ES6, ES7, ES8 all reflected a decision to enter the workplace due to pressure to get a job and deferred entering their honours until later in their careers. ES6 completed her honours via correspondence. ES7 and ES8 completed their honours while employed.

Direct transitioning into masters was reflected in the stories of ES1, ES3 and ES4. ES4 explained that "I went on to do my masters to buy time to think of what I was going to do". However, ES1 did not eventually complete his write-up although the research work was completed for the university. ES2, ES7 and ES8 completed their masters while working. ES2 reflected that she did her MSc part-time while she worked and "found the opportunity to apply practical work experience in

my studies was very stimulating ... it was also where my main interest in environmental issues became evident". ES5 and ES6 do not currently have master's degrees.

ES8, although working with a university as a senior lab assistant, struggled to find a supervisor at his institution as he was trying to set up masters that he could build into a PhD and had to study at another institution at his own cost. ES4 completed a PhD while working within the Department of Agriculture, where he used one of his work projects as the basis of his PhD research. ES7 is currently completing a PhD part-time with a climate change focus.

8.4.4 Understanding the experiences of transitioning into work

The career stories reflected the bridging into work as a relatively uneven, bumpy transition. ES6 (even as a Black female) was unemployed for a year and spent time working as a cashier at a postal company. ES3 and ES5 worked as research assistants at the university while continuing their job searches. ES4, ES7 and ES8 were unable to get jobs in their field and started working as teachers. ES4 further explained he was unsure what exactly to do and where he could work after his degree, while ES3 reported she "had no idea what an environmental scientist did". Hence it was only ES1 and ES2 that reflected a smooth transition into work. The data emerging from the career stories is consistent with the data presented in section 6.3 from unemployed graduates joining a sector incubation programme. That data presented there also highlighted the inability of environmental graduates to transition easily into first jobs.

An important entry point into work appeared to be small environmental consultancies, as reflected in the career stories of ES1, ES2, ES3, ES5 and ES9. However, this is not uncommon as both UK and Canada report environmental consulting firms as a major employer in this area (Schultz, 2015).

ES1 reported that the transition into a small consultancy meant he was expected to work as a 'jack of all trades', but because it was an ecological consultancy he immediately had to specialise and focus on aquatic toxicology and aquatic ecology. Thus, despite his geography and environmental management background, he was immediately expected to work within science roles. Similar experiences were reported by ES5 and ES3 who also reflected that they were thrown into managing projects and specialising roles without much overall introduction and understanding of the broad scope of environmental science work. ES3 reflected that it may have been useful to have done a two-year internship that introduced you to the different specialities (like doctors) before making specialisation choices.

The complex nature of the challenges raised here will be explored in greater detail below as I explore the factors influencing learning pathways of environmental scientists.

8.4.5 Understanding the mobility patterns of environmental scientists

The mobility patterns of environmental scientists are consistent with the premise by Sawchuck and Taylor (2010) that job mobility is increasing. The career stories reflect many and numerous inter- and intra-organisational movements.

The inter-organisational movements reflect movement into and out of mostly environmental consulting firms. Of the nine interviewees, only two have transitioned into para-statal organisations; the other seven career stories reflect mobility patterns between small to large consulting firms.

Intra-organisational movement is linked and related to working on projects. Largely the intra movement is prompted by roles with projects hence depicting largely lateral movements, with very little upward movement except when moving into a more senior role within a project.

Ng et al. (2007) as discussed in section 4.4.2.6. listed structural factors as an important determinant of mobility. An important factor emergent from this projectification work is that people are employed on contract within projects. Thus contract duration become an important structural factor influencing job mobility (ES5, ES2, ES4, ES7). Guile's (2014) description of "projects as an organising principal of work" (ibid, p85) is useful in describing how the stories reflect interviewees work being organised into projects and work across the organisation further being reflected as projects.

A further structural factor is the ability or inability to be recognised by SACNASCP as a registered natural scientist, making professional status a critical structural factor influencing mobility. ES1, ES5 and ES6 were all unable to gain professional recognition, as the only registering body is SACNASCP which does not accredit a geography environmental management route into sector as discussed in section 8.2.4.1. Hence none of these graduates will ever be able to be senior environmental scientists. Hence ES5 and ES6 continue to work as junior environmental scientists and their mobility patterns reflect movement into and out of many different projects. ES1, frustrated with this barrier, has transitioned into project management more formally and currently manages "several projects from logistical (time, budget) and quality".

8.5 Factors influencing the learning and work transitioning of environmental scientists

Drawing from the evidence presented in this chapter, the discussion below highlights the factors influencing the nature of the environmental science learning pathway.

8.5.1 Identity and visibility of discipline within Higher Education

The career stories as well as broader data drawn from interviews at four institutions highlight that tensions exist around the 'identity of the qualification' (In13).

Data collected from institutional interviews describe environmental science as a discipline, which although growing very fast, is still largely emergent within university learning programme framing. Environmental sciences and environmental management is essentially offered largely as either "Environmental Science – a four-semester subject which may be taken as a major subject for the degrees of BSc, BEconomics and BA" (In16) or as a specialisation within BSc (In14; In13) or within social sciences as a specialisation within geography.

The data suggests emerging tensions both at level of student and level of institution. Reflecting on the subsidies received from registered environmental students, it appeared that subsidies were "going to the 'Geog Pot'" which hinders the development of environmental management within university (In15), also echoed by In13 who explained "almost 90% of Honours students in the department are environmental but budget and subsidy goes to Geography". Further institutional issues raised show "little advertising for environmental science within university" (In13) with "very little information available on courses and very little attempt to expand and develop into independent environmental unit so we see a continued dominance of geography in structuring of environmental management degree" (In15) and furthermore "an attempt to protect traditional academic subjects" (In13).

Furthermore, tensions were raised that highlighted that students registered on environmental science programmes "feel isolated" (In 13) and as explained further by In13 "many do few core environmental linked subjects but many traditional science subjects, thus feel that they are largely the same as all other BSC students".

The discussion has raised some pointers that illuminate why some undergraduate students may not feel that they are on an environmental learning pathway during their studies.

8.5.2 Regulation and Professional Association

To be a registered professional environmental scientist, students need to register with the Council for Natural Science Professionals, who, as described in section 8.2.4.1. above, insist on core natural science subjects (traditional subjects). This implies that students can not only focus on environmental science and their major subjects, but need to include traditional subjects from the natural sciences disciplines such as zoology, botany, chemistry and physics. This results in graduates entering workplaces without a strong or complete grounding in core environmental science issues. The knowledge on issues and interests that are relevant to the environmental sciences may not be well developed even though there is a case to be made for some 'core science' background in the environmental sciences. The difficulty is to determine what level and balance of core scientific disciplinary knowledge and core environmental sciences knowledge is necessary, especially because environmental sciences become specialised at postgraduate levels.

The data discussed above (ES5, ES6, ES7) also indicates that it is not possible for students emerging from the social sciences to join the Council (SACNASP 2012a).

The professor interviewed (In15), who is well reputed and has been involved in various environmental management projects, is unable to register despite her PhD and experience due to her undergraduate degree being social science (geography and environmental management).

Clear examples from the career stories of ES1, ES5 and ES6 indicate that inability to register is a clear constraint on progression and career development. ES5, despite having a university degree and eight years' experience, is unable to progress beyond junior environmental scientist. Thus the differing labour market value of the different types of qualifications is an important factor in enabling or constraining pathways.

In the short term, there is need to make clear access points for social science graduates to be registered and recognised as professional environmental practitioners. In a more systemic long term perspective, the evidence in the study as raised tensions points for how emerging multi-disciplinary occupations are regulated and recognised within traditional accreditation frameworks.

8.5.3 Subjectivity of Environmental Science and Environmental Scientists

The relative young nature of the discipline in South Africa and its emergence and positioning as a multidisciplinary discipline, raises important questions on how disciplines deal with boundaries and how students and programmes cross disciplinary boundaries. The data in the study has raised

important insights into how environmental science is interpreted and accommodated in different institutions and contexts. This also highlights the important boundary crossing role these workers play.

In section 8.4.1 I discussed the identity of environmental sciences within higher education. Shackleton et al. (2011), reflecting on the horizon on environmental sciences in South Africa, suggested that it would bring together sustainability science, resilience science, social learning, environmental justice and governance, environmental economics, environmental modelling and scenario development – all of which span traditional ecological, biological or geographical competencies but at the same time are linked to broader social science understandings in economics, governance, politics and human behaviour. This description is holistic and very useful but also indicates that to produce competent graduates, there will be essential boundary crossing across traditional disciplines.

In section 8.3 I outlined that most of the occupational information within the post-school system views this role largely as an environmental impact assessor and fails to capture the breadth and scope of the occupation. Tolbert (1996) emphasised that as organisations become less important in defining career pathways, occupations will become more important. This suggests an increasing centrality of occupations in career arrangements (and potentially also in skills development system planning and provisioning). This would mean that people's occupationally based careers provide a means for signalling their ability and competence. This in turn requires a social understanding of the clearly defined set of skills and knowledge (and values as shown in the environmental sciences occupation) with a distinctive set of tasks, against which these skills and knowledge can be applied in an occupation. This is the foundation against which an occupational group member can be held responsible. This, Tolbert (1996) argued, lays the foundation for the occupational labour market. This clearly needs to be more carefully considered for environmental sciences.

The career stories assist to contextualise the 'concrete universal' transitioning experiences of practising environmental scientists and help to illustrate that in shaping their careers they have followed pathways depicting nomadic movements across organisations, across knowledges and across work relationships (Fenwick, 2006). All the stories reflect different instances of being unsure of their subject position. Some employers recognise this:

... lack of maturity in a new discipline, abundance of young people entering, unsure of themselves in an unsure environment, also senior managers white and few. Definite need for building maturity so we can emerge as a cohesive field. (In18)

Another important emerging subject tension raised by interviewees is related to how they work with business. ES3 reflected on trying to work in a business world:

... because I don't have any business training, I cannot speak to the businesses around me and they are fantastic opportunities – the thing is I cannot speak at the level required to capitalise on the opportunities and work well with them... there is a communication barrier between the different people involved. (ES3)

ES1 reflected on how the role he is playing now in work was different from how he saw himself at the start of his career, where he had the idea he was working to save the world. He reflects he has slowly had to accept:

Environmental managers don't save the environment ... they help people bugger it legally ... and I think if you look at the past 20 years if not more of this type of career, it's really what we have done to a large extent, we have minimised the damage, but we still allow people to bugger it up legally as opposed to saving something because then we would stop all development and that says something which is unrealistic in South Africa. (ES1)

This section has tried to highlight some of the different and differing subject positions the discipline is facing both systemically within the post-school sector as well as within practising professionals.

8.5.4 Environmental science – skills needs in a rapidly evolving discipline

Across this chapter there has been evidence of an emerging transitioning discipline that is trying to find a position in the post-school system. Working in this type of space is dynamic and exciting but also raises challenges for universities who have to reflect on the types of programmes and type of graduates they need to produce. This well captured by (Shackleton et al. (2011): “the discipline is evolving so swiftly, university curricula and research programmes must keep abreast by scanning the horizon for emerging issues in the near future” (p. 2).

Shackleton et al. (2011) further explained that post-school education requires broad multi- and inter-disciplinary teaching and research programmes to equip graduates and researchers with core competencies of sustainability science, adaptability, innovation, dealing with uncertainty and trade-offs, social learning and integration of different knowledge systems.

Workplaces face the brunt of this rapidly changing field as they require graduates that can

function in multiple diverse contexts and have a variety of skills; quick thinking in the field was one that emerged as extremely important as reflected in the interview extract below:

... biodiversity assessments – going into field, assessing what’s there, seeing beyond obvious – requires knowledge, interest and experience and being good at fieldwork requires more than what you learn in books, there needs to be a drive to “see and understand the natural environment” and a definite interest in natural world. There is insufficient fieldwork in undergrad degrees. People coming out walk in field and are unable to identify species and lack skills to do species identification ... even with a masters they have a colleague that is very knowledgeable but lacks fieldwork skills (can talk about species knows info but when in field doesn’t have quick ability to identify assess what’s there what’s not). (In18)

Another consequence of a rapidly changing field, all career stories reflect blurred boundaries between education and work. The stories all reflect cases of extended transitioning and many reverse transitions into education and then back to work. These transitioning experiences gives structural and systemic insights and illustrate that workplaces require continuous knowledge and skills updates and hence emphasise the importance of continuous professional development in environmental sciences. This is, however, not different to the discipline internationally; as reflected in a UK review by Shaw and Kemp (2011)

In this context, the very nature of environmental science creates a need for CPD. The continually and often rapidly changing landscape of environmental science acts as an extrinsic factor that incurs a need for frequent enhancement of skills, knowledge and understanding. Given the dynamic nature of legislation, economy, and political imperatives, for example, an effective environmental scientist can rarely meet emerging needs without adopting a pro-active approach to training, practice, and learning. (p. 40)

8.5.5 Absence of parallel pathways

Positioning of the qualifications as academic and scientific levels prohibits the creation of multiple entry routes. The sector hence needs to explore greater connections to entry-level and technical qualifications to enable better access into the sector at artisan and technical skill levels (see section 8.1.4). The safety nets for this academic pathway are unclear – and students that dropout or fail to gain access have little options. Because there are few or no intermediary learning pathways (see section 8.1.4), high skill staff are often underemployed (In11 and In12) and tend to be used in positions that could be filled by technicians (e.g. employing masters graduates and using them in technical roles that could be filled by N Dip candidates) (In12).

This also reflects an absence of a safety net or second chance option for environmental science students, which as discussed in section 4.3 is critical for enabling access and little evidence was found of linking to vocational pathways (FN6 and FN14). In the meeting to discuss possible

formation for an environmental technician vocational course (FN14), no known programmes were identified or known. This is a concern in South Africa, as Wheelahan (n.d., p. 2) emphasised, “educational pathways deepen participation in education by existing social groups but do not effectively widen participation for groups that do not have equitable access”; hence enabling access through multiple entry point is a critical component of refining pathways in this sector.

8.6 Mechanisms underpinning the pathways of environmental sciences

The critical realist lens used in the study enabled me to shift focus from events that can be empirically observed and experienced to develop a clearer picture of the mechanisms that have produced the events and experiences. Drawing from the context outlined in sections 8.2 and 8.3, the empirical reality that emerged from the career stories and the systems overview, I then used critical realist retroductive analysis to highlight the causal mechanisms that could be influencing pathways of environmental sciences. Figure 8.5 that follows is a causation diagram that illustrates the empirical, actual and real.

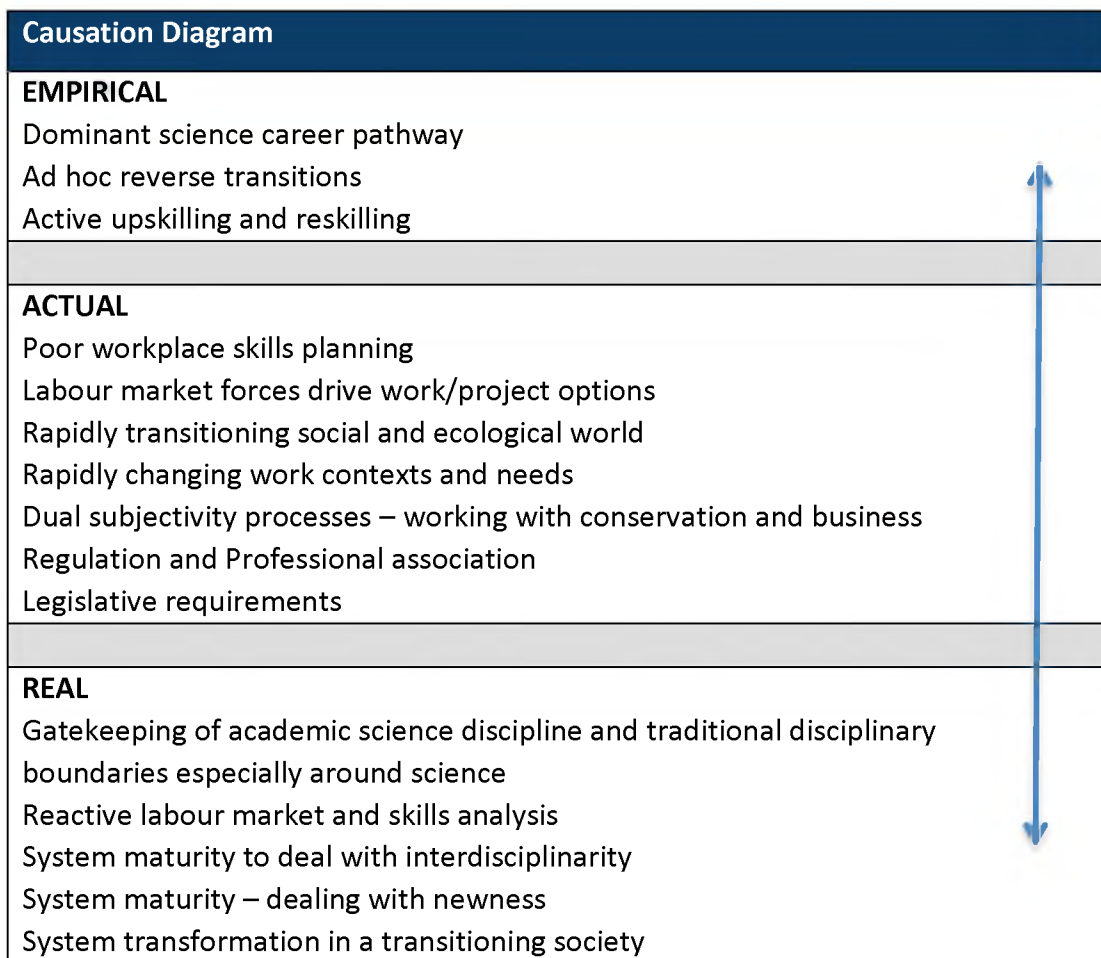


Figure 8.5: Causation diagram

8.7 Conclusion

The evidence presented in this chapter has raised some interesting observations on how official maps of pathways for environmental sciences are understood in the post-school system alongside presenting and analysing stories of practising agents, who are navigating the post-school system and creating individual pathways.

From a critical realist perspective, this chapter has attempted to outline largely the *actual* and the *empirical* while the factors influencing pathways started unpeeling the layers of the real to ensure that the presentation of the pathways of environmental scientists is not a flat conception of reality.

CHAPTER 9: ENVIRONMENTAL LEARNING PATHWAYS – TOWARDS A NEW AND IMPROVED STORYLINE

To be is to be able to become.

Bhaskar, 2010, p. 53

Becoming is the absenting of what was in favour of the emergence of what now is, for every becoming is also, in some part at least a 'begoing' an absenting of what was there.

Norrie (2010, p. 15)

9.1 Introduction

The central question this thesis has tried to explore, is to understand the nature of environmental learning pathways and the systemic and agentic factors that shape them. As argued in sections 1.3 and 1.4, to be able to conceive an environmental learning pathway as a complex phenomenon, I needed to develop a frame that would allow me to understand the nature of the transitioning system we are operating within.

Hence transitioning systems discourse in this thesis is inherently a discourse of multi-level, multi-domain change as introduced via the multi-level perspective presented in Chapters 1 and 2. A core interest of the multi-level change needed to support seamless learning pathways in the transition to a greener economy is how to conceptualise and enable change on individual, meso (systems) and macro levels (planetary) as discussed by Bhaskar (1993), Shipway (2010) and Norrie (2010) (see section 2.3.) As illustrated across this thesis, I have drawn on the work of the Multi-Level Perspective (see section 2.2.1.) and Bhaskar to provide a more refined framework for analysis of micro-macro emergent relations; hence the multi-levelled analysis I present in this chapter is framed within Bhaskar's idea of laminated systems, in which he argued that "a necessarily laminated system was a system in which a particular level could not be reduced away" (Price, 2012b, p. 2). Working with the idea of laminated overlaying systems and relations of emergence helped to build a stronger conceptual framework for learning pathways as an 'articulated totality' (Price, 2012b, p. 2), and to frame learning pathways research within a laminated systems perspective.

In this chapter I thus deepen and extend the accounts presented in Chapters 5, 6 and 7 using Bhaskar's MELD schema drawn from Dialectical Critical Realism (DCR) (see Chapters 2 and 4 for

discussion on MELD). Additionally, and through the reflective analytical work in this chapter that draws on DCR, I argue that through exploring the possibilities for transformative praxis we can shift notions of reality in green skills research from being to becoming.

Recommendations framed in this chapter are therefore also to be read as transitional system possibilities in which environmental learning pathways can be furthered within a view of moving from existing being (the way things are) to becoming (the way things can potentially be, i.e. that is in transition) as proposed by Bhaskar (1993, 2010) and Geels (2010). My recommendations are made within the framework of a laminated system and seek to frame possibilities for transformative praxis within a wider transitional systems perspective.

To date there has been no research that has viewed learning pathways and the emergence of learning pathways in a systemic framework in this manner, especially not in the South African NQF and emerging Green Economy context. This therefore also helps to contribute to the claim to new knowledge made by this thesis.

9.2. Environmental learning pathways as a laminated system

9.2.1 Drawing the threads together

The argument developed in this thesis has shown that environmental learning pathways are best conceived as a complex phenomenon, constituted by dialectically interdependent planes (dynamic interplay between what is present and what is absent and their interdependence). I have tried to illustrate that for a full understanding of environmental learning pathways, it was essential for me to refer to multiple levels of reality that exist, relate to and impact on each other as an articulated totality. As Bhaskar (2010) explained there is not one level of causation for explaining phenomena; hence it is necessary to explain different mechanisms, structures and agencies and their relational emergence within a constellational whole. Thus across Chapters 6, 7 and 8, I have attempted to provide a laminated explanation of the macroscopic (or overlying) and less macroscopic (or underlying) kinds of structures or mechanisms that shape and influence environmental learning pathways (both as a provisioning system for green work (Chapter 6) and through the analysis of two occupational case studies (Chapters 7 and 8). This enabled me to show that, unlike Heinz (2009) who stated that “transition biography can be reconstructed as a sequence of expected and unexpected outcomes of choices” (p. 400), this study has illustrated the structural shaping of agentive action embedded in the shaping of learning pathways.

In Chapters 6, 7 and 8 I have further illustrated that many environmental occupations are specialised occupations. Understanding the nature of the learning pathway associated with an environmental occupation is thus contingent on the proper understanding of **both educational progression as well as occupational progression** and the education and training platforms that support this. This I contend has proved to be a useful conceptualisation of environmental learning pathways. This conceptualising further emphasised the need to see learning pathways as a necessarily laminated system (see section 2.3.2).

Environmental learning pathways can be described as being *emergent* i.e. in most cases these were still in development from a systems perspective; hence the use of the multi-level devices, introduced in Chapter 2, enabled me to outline the levels of reality necessary to develop more satisfactory non-reductionist explanations of environmental learning pathways. The discussion across Chapters 6, 7 and 8 enabled the development of a holistic picture that illustrates the “relations of emergence and dependence” (Parker, 2010, p. 208) that are integral to environmental learning pathways. This helps to clearly illustrate that environmental learning pathways are constituted as emergent phenomena across interdependent planes (see Figure 9.1).

Figure 9.1. below illustrates some of the multi-mechanisms at play across the different levels of scale explored across Chapters 6, 7 and 8 and helps to emphasise environmental learning pathways as totalities comprised of “intra-actively changing embedded ensembles” (Bhaskar, 1993, p. 117). The depiction of elements across levels of scale that emerged as relevant to the nature of environmental learning pathways is consistent with Bhaskar’s notion that totality is itself structured, and so may contain or be contained by dialectically contradictory or, on the other hand, mutually reinforcing or supporting relationships (Bhaskar, 1993).

Thus this thesis has shown that sustainable development occupation learning pathways are relevant to different ‘parts’ of the education-training-workplace system and include: learning in the activity systems of the workplace; interacting systems of workplace learning and training; and the system of providing of training which is differentiated into sub-frameworks in the NQF (see Chapter 6). Significantly, within the context of this study at this time in South Africa, the study enables a transitioning education and training system to see the elements integral to joined-up implementation that can support the emergence of a more pro-active framing of environmental learning pathways.

Figure 9.1 uses Bhaskar's (2010) seven scalar laminated framework (as discussed in section 2.3.2) to consolidate some basic emergent elements of environmental learning pathways (at different layers of scale), which are named below as analytically separate but are, in reality, systemically whole consolidating the **inter-related** meta elements emergent across the chapters of this thesis.

The laminated system synthesis of environmental learning pathway elements presented below in Figure 9.1 depicts important elements at various levels: the global societal level, the level of post-school education and training, the level of work systems at employer levels and lastly, the individual level.

Figure 9.1 highlights that at the level of societal landscape, environmental learning pathways construction is influenced by the environmental condition itself, new legislation and compliance demands (section 3.2.1.), resource efficiency and cost saving, emerging opportunities associated with the green economy (section 3.2.1.3) and historical and contemporary political economies of education and environment (Chapter 3).

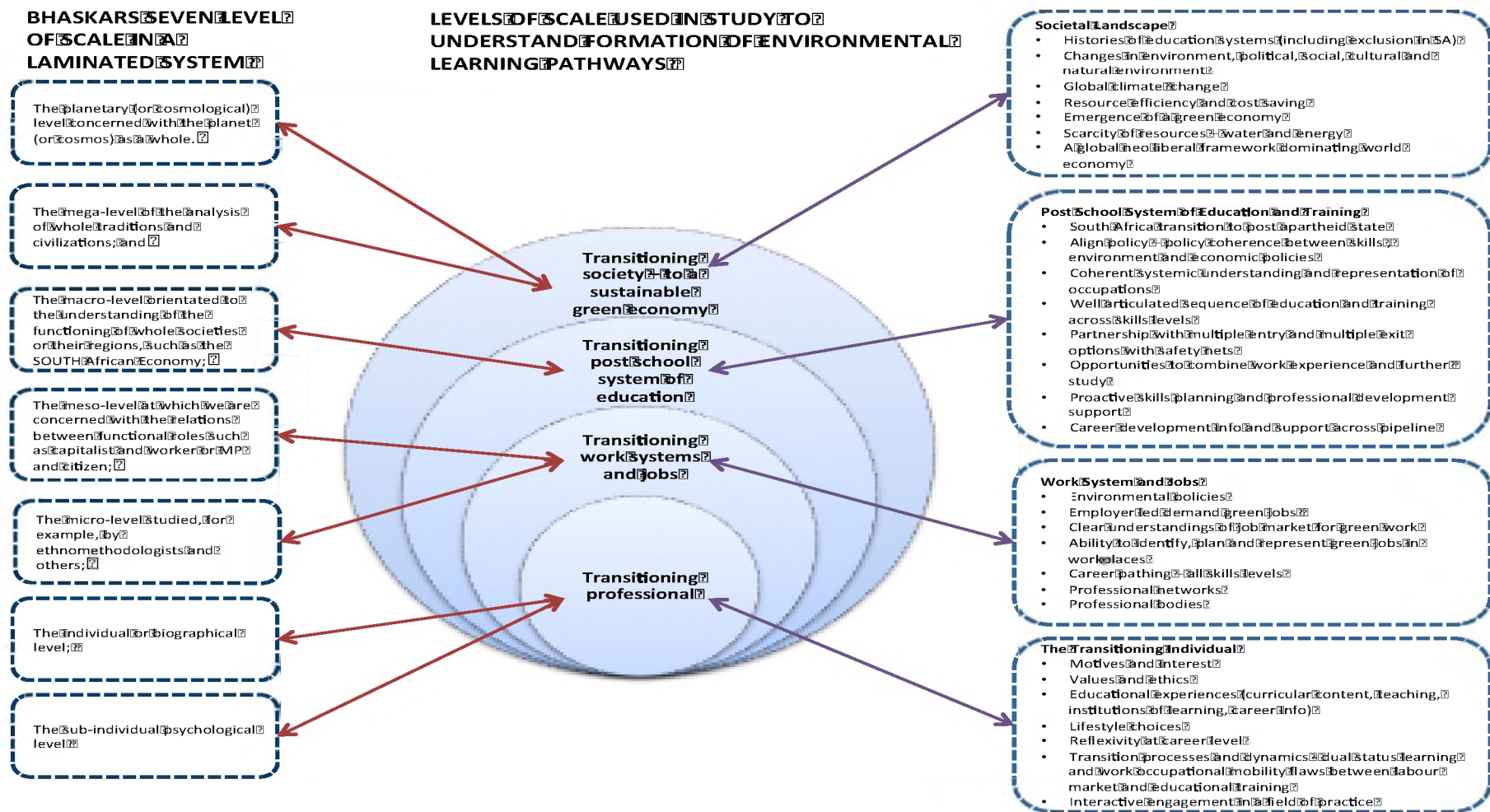


Figure 9.1: A laminated explanation of environmental learning pathways

The role of the transitioning individual agent, also shown in Figure 9.1, is an important consideration in pathway construction. Educational experiences, lifestyle choices, reflexivity at career level (as depicted in career stories in Chapters 7 and 8).

Figure 9.1 further shows that learning pathways are relevant to different ‘parts’ of the education-training-workplace-environmental system in South Africa. Policy coherence between environmental coordination and education and training is essential (section 6.11). At the level of the post-school system, emergent important factors include articulation across sub-frameworks of the NQF and across levels of skill (sections 6.4; 7.3.2.; 8.2.4). This supports the argument for **articulation as a significant ‘relational element’** within a systems approach to learning and work to actualise progression of students. Developing a wider systems perspective on the notion of articulation raises the need for systemic articulation across work and education systems and the broader idea of articulation as complementarity (Wheelahan, 2009).

Adopting a transitioning systems perspective (as shown in Figure 9.1), however, without a critical realist lens could have resulted in simply describing *what is* happening and seeing this as adequate. As shown in this study, adopting a critical realist dialectical vantage point in this research has helped to identify both what is happening and how, but also to point more clearly to the absences i.e. what is **not (yet) happening** and how it might be possible to develop the system in ways that are more pro-active. It thus allows for a *system development vantage point*.

In the next section, I use Bhaskar’s Dialectical Critical Realism and the notion of absence to deepen the explanation of environmental learning pathways and hence lay the foundation for transformative praxis which is central to the interest of this thesis.

9.3. Absenting absences – Exploring opportunities for transformative praxis

Across this thesis I have presented insights into the complex nature of environmental learning pathways. In this section I surface the absences observed in environmental learning pathways. Drawing on Bhaskar’s (1993) dialectical argument I contend that DCR plays two important roles in this thesis: firstly, it enables me to argue that learning pathways are equally influenced by what is not there (thus helping to ascribe causality to something that is not present) and secondly, understanding these absences provides the openings for transformative praxis necessary for reconstituting and / or constituting environmental learning pathways. Working with absence helps me to re-imagine ‘holistic totality’ in terms of what a system for seamless pathways for green

work would encompass and thus enables consideration of opportunities for transformative praxis of current learning pathway frameworks.

I begin with a short contextualising discussion on absence as an integral construct in dialectical critical realism (see section 4.5.2 for discussion on DCR).

9.3.1 A focus on absence

This section draws on the conceptual tool of absence as the primary category of DCR. It sets out to investigate the deep-seated absences and the dialectical process of change that a focus on absence can enable (see section 4.5.1). This prioritises absence as a central concept in being and implies that presence is inherently part of absence hence giving primacy to absence.

One of the ways of understanding what is absent described by Bhaskar is to examine what is present somewhere else (Bhaskar, 1993; Shipway, 2011; see sections 4.5.1 and 4.5.2). For example, studying how occupations are differentiated in agriculture provided insight into systemic elements that are absent in the environmental sector (see section 6.5.4) or to study qualification routes within engineering (see section 7.3.2) provided insight into the nature of what systemic aspects are absent within the environmental sector (I discuss these absences in more detail below). Exploring how absences may be spatio-temporally distant, or present elsewhere is helpful for formulating possibilities, re-imagining practices and conceptualising a more coherent learning pathways framework for green skills in South Africa. Absence, as also argued by Bhaskar (1993), is a vital concept to theorise change, as it implies incompleteness.

9.3.2 Absenting as a normalised practice in crafting pathways for green work

Through constructing the learning pathways discourse as a complex multi-level phenomenon in this study (see section 2.4, Figure 2.4 and Figure 9.1 above), it was possible to surface various “internal contradictions and apporia” (Bhaskar, 2010, p. 21). Bhaskar further explained

The levels may be conceived as constituted by absence and omissions and various contradictions, as internally as well as externally related, as concrete and holistic and as involving processes dependent on transformative praxis understood as occurring on all four planes of social being, at up to seven orders of scale and as crucially dependent upon our discourse as a constitutive causally effected and efficacious feature of social life. (p. 8)

Across the career stories (Chapters 7 and 8) as well as in the systems analysis (Chapter 6), the environmental learning pathways studied were characterised by absences; these absences shaped the nature of the environmental learning pathways considered for the two occupations and were

integral to the actualisation of the pathway. The career stories presented (in Chapters 7 and 8) clearly illustrated how absencing could be viewed as a normalised practice within the crafting of environmental learning pathways.

Drawing on Bhaskar (1993), Nunez (2014) argued that envisaging holistic totality (being as whole) includes its splits, gaps (partial totalities) and its boundaries (sub-totalities). Nunez further outlined that mapping this totality can be described as a “constellation that maps a system of internal relations” (2014, p. 26). In this study, such a process would encompass the possibility of mapping a better learning pathway system for green work incorporating differentiated skills formation systems across all three skills bands (high, intermediate, low - see section 1.5.3) and hence enable creation of a multiple entry, multiple exit system.

In the following section, I discuss four key absences identified in this study. I have selected to discuss these further as they are central to unlocking the transformative praxis possibilities for skills development in the environmental sector. These absences are:

- **absence of qualifications** at different levels of the NQF, especially entry and intermediate levels;
- **absence of occupational differentiation** in both skills level and specialisation and in terms of how occupations will change;
- **absence of comprehensive career development information** and career development support; and
- **absence of skills planning mechanisms** or mechanisms to connect supply and demand in relation to green jobs within a futures perspective.

In the discussion below, I first present the nature of the absence in a brief MELD frame (see section 4.5) and then examine these absences in greater detail as interconnected within a laminated system frame. The four levels of MELD (section 4.5.2; Bhaskar, 1993; Shipway, 2010) can be summarised as follows:

1M - Being (what's real, actual)

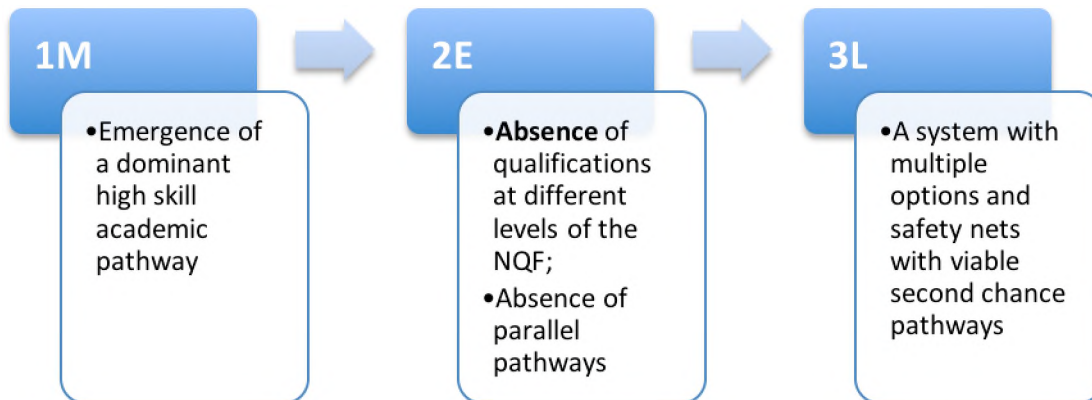
2E - Absence (what's not there – causal power of absence)

3L - Totality (what could be there – reimagining totality)

4D - Transformative praxis (what are the possibilities – how could it come into being)

I have selected to present the first three levels of Bhaskar's MELD and the fourth level 4D is presented collectively in the next section so as to avoid duplication of the 4D analysis.

9.3.2.1 Absences in the qualification system



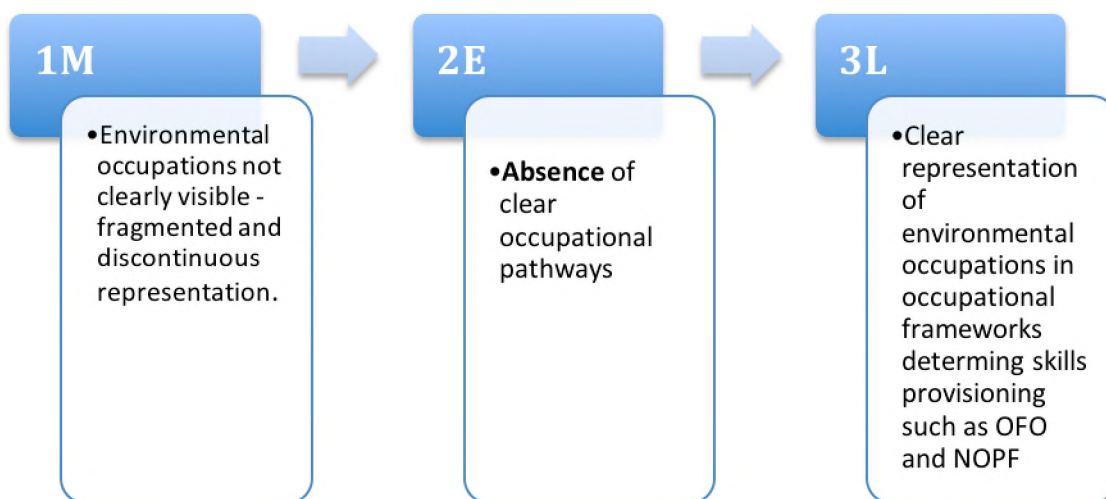
1M: Evidence presented in section 6.4 highlighted that qualifications provisioning in South Africa is characterised by a focus on high skills, scientific specialisation, and mainly postgraduate qualifications. This is further corroborated by the data on access to specialisms presented in the environmental engineering and environmental sciences chapter (see sections 7.3.1 and 8.2.4).

2E: The absence of qualifications at different levels of the NQF is thus largely characterised by the absence of low /intermediate skill qualifications which I earlier articulated as the 'missing middle' in the environmental sector (Ramsarup & Lotz-Sisitka, 2013). This high-skilled scenario tends to constrain the emergence of a well-articulated provisioning system for the environmental sector by hindering the emergence of new or parallel learning pathways from technical into professional pathways and by not providing connecting points for artisan pathways. Hence, by surfacing what is absent (the low and intermediate skill qualifications), it is possible to make sense of what is present (the dominance of high-skilled academic pathways). This also reflects a lack of safety nets for students on an academic path and little options for second chance pathways into the sector (see sections 6.4, 7.3.1 and 8.2.4) which are necessary and essential in African countries to broaden access and progression (Hoppers, 2009; section 4.3).

3L: This emergent 'missing middle' constitutes a stratum that can potentially enable better learning pathways, and which can potentially provide articulated access when connecting to artisan and entry occupations. It could enable movement of entry-level skills into intermediate occupations and it could provide the mechanisms to enable parallel pathways broadening access options and supporting a stronger framework for learner progression. As shown in Chapter 7, such

possibilities already exist for the wider engineering profession, which indicates that such a conceptualisation of learning pathways is possible. In section 4.3 I explored how existence of a multi entry multi exit system is a central element in learning pathway systems. Hoppers (2009, p. 80) writing within the context of lifelong learning in Africa, emphasised that more “effective articulation within an integrated system enables parallel and second-chance pathways to emerge that disadvantaged learners can use to move through quality education provisions from basic education through upper secondary education into higher education”. Cedefop (2012) and OECD (2014) both recognised the important catalytic role of qualifications on provisioning for green skills.

9.3.2.2 Absences in occupational information and systems



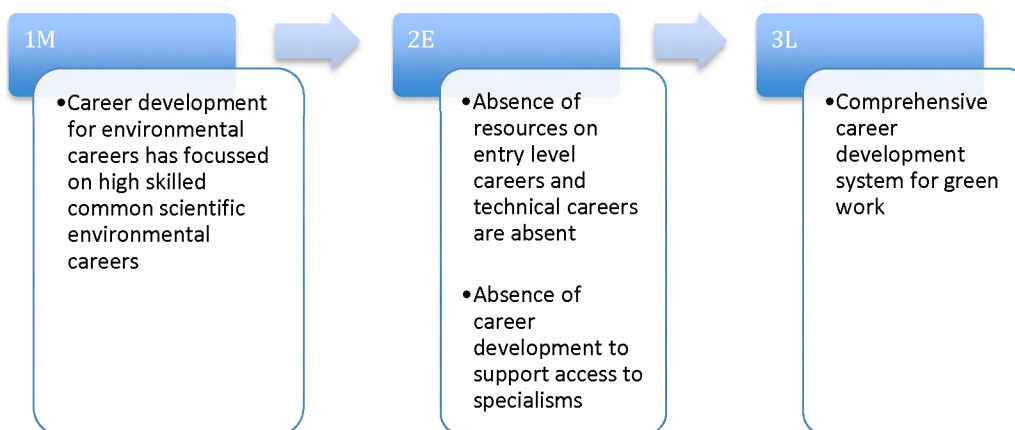
1M: Sections 6.5, 7.3.3 and 8.3 highlighted the poor and poorly constituted representation of environmental occupations at intermediate and elementary skill levels in the South African skills development system instruments such as the OFO and NOPF. As reported in these sections, environmental occupations appear scattered and are not visible across levels of skill. Currently occupational categories for most environmental occupations are either a) missing on the Organising Framework for Occupations (OFO); b) inadequately differentiated; c) lacking in coherence; d) or lacking in coherent progression pathways and possibilities creating fragmented snapshots of occupational families.

2E: The absence of occupational differentiation at micro levels across skills levels and specialisation is emergent as unclear occupational pathways, hence the absence of a visible depiction of ‘families of occupations’ relevant to the environmental sector learning pathways (South Africa. DHET, 2012). This means that related environmental occupations are not

adequately represented across the different skill levels of skill in the Organising Framework for Occupations (see section 6.5) which makes it difficult to depict clear occupational progression within environmental jobs. The absence of these clear family clusters of occupations thus influence the (lack of) information on green work shared with and used by employers, human resource professionals, education and training professionals, and the STATS SA who undertake the annual workforce labour survey (South Africa. DEA, 2010a). This impedes monitoring of green employment, and the development of these occupations, it influences funding flows (and lack thereof) to green skills. It also impedes understanding of potential progression pathways and career pathways, which assists occupational qualification developers to lay the foundation for vertical progression when developing occupational qualifications.

3L: In skills development and planning, the ‘language of occupations’ has become the dominant code of meaning, and it has been expressly stated in the NSDSIV (South Africa. DHET, 2015) and DHET skills planning policies that occupations are to be the major organising frame for skills analysis and planning. The ‘language of occupations’ therefore holds power as this is where resources and allocation of resources for developing the national system of skills, qualifications development and skills planning are centred. Identifying absences such as those identified above starts to intensify concern around systemic articulation for green occupations within an occupationally driven system of skills development. The possibility exists to include clear descriptions of a wider range of green occupations as has been shown in the North American context where a ‘green OFO’ exists. As reported in section 6.5.5, this has already been seen as a potential route for South Africa.

9.3.2.3 Absences in career development systems for environmental occupations

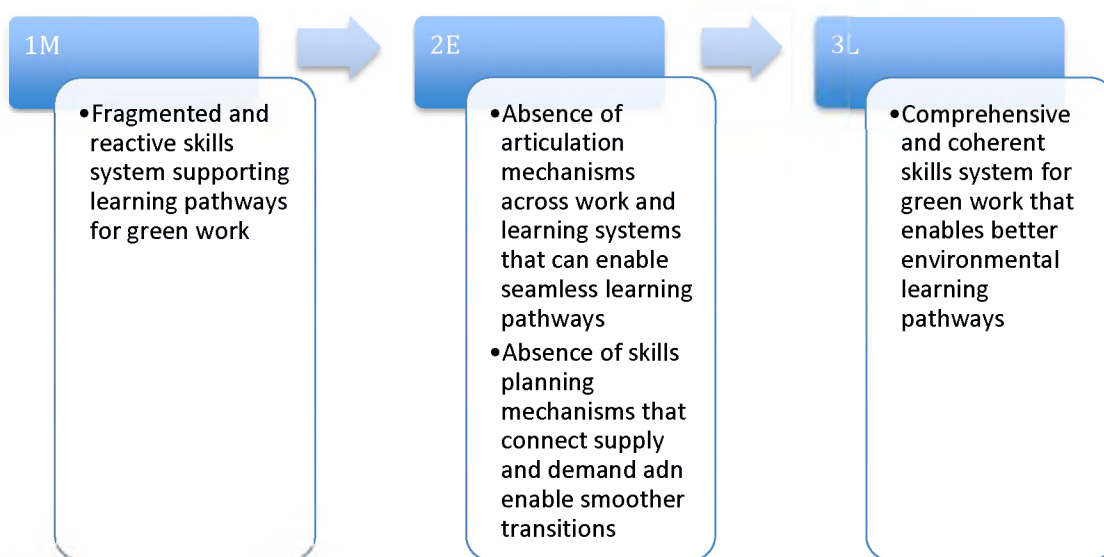


1M: Data presented in section 6.10 as well as data on career information presented in Chapters 7 and 8 illustrate that the dominance of high skill occupations and qualifications is perpetuated within career development systems. Available career information related to environmental careers is linked to widely known and traditional jobs. Furthermore, evidence presented in section 6.10 has illustrated that career information is directed largely at the student transitioning from school into university.

2E: The data presented in the sections listed above clearly illustrates that information related to artisan, technical and low skill careers is absent from mainstream career systems like the National Career Advisory Portal (NCAP) as well as widely used environmental career guides (see section 6.10). This absence is clearly interrelated and emergent from the two absences presented above in relation to absences of qualifications and absences of broad occupational framing. Movement into specialist careers is predominantly advocated through a master's degree (high skill qualification). This further supports the notion reported in several interviews (In12; In13, FN14; FN15) that "to work in this sector you need a master's degree". Career information for graduates and people transitioning into specialised work is largely absent.

3L: Clear signposts and high quality information are needed, as well as advice and guidance on green careers (that is well entrenched in national systems of career guidance like NCAP – see section 6.10). With clear and coherent occupational information emerging across different levels of skill (section 1.5.3.), career development information and guidance will be more inclusive, comprehensive and contain information for a broader selection of green work at entry, intermediate and high skill levels. Also career systems will depict careers beyond science related fields to broaden social awareness of other types of environmental work and are able to present the full scope of environmental jobs (see section 6.10).

9.3.2.4 Absences in coherent skills planning mechanisms for green work



1M: The necessity for a coherent skills planning mechanism is intensified within the South African context with its intention to create significant numbers of jobs in a green economy – 300 000 - 400 000 green jobs (ILO, 2011a; Maia et al (2011); Borel-Saradin & Turok, 2012; UNEP, 2013). Currently, the skills planning is characterised by an ad hoc, re-active approach to planning for green work as reflected in Chapters 6, 7 and 8, and as reported on by the Department of Environmental Affairs (South Africa. DEA, 2010a) which provided the impetus for this study. Chapter 7 illustrated how the education and training system was unprepared for the emergent demand for environmental engineers, which has resulted in supply systems being unprepared to meet the emergent demand. Chapter 8 further illustrated the workplace confusion between the demand for environmental scientists and environmental managers and the supply systems that are training general environmental scientists who are being utilised immediately as environmental managers. Chapter 6 showed, despite good intent, there is very little evidence of skills planning for green skills entrenched with the current skills mechanisms and systemic frameworks and certainly not at different levels of skill.

2E: In considering this elite high skills academic phenomenon more critically, retroductively, one might hypothesise that (at the level of the real) there is an absence of an appreciation of the value of low and intermediate level skills (jobs) in the environmental value chain and the necessity to understand and plan for it.

Environmental training for low /medium level workers appears reduced to knowledge of the rules and safety/health and environmental management systems, and neglects more complex forms of

environmental knowledge which in many instances is simply ignored or not engaged with in training at all, as shown in some empirical studies (e.g. Mohanoe, 2013; Maphinyane, 2013; Fourie, 2014; Burger, 2014). The pathway options for these low/intermediate level appears neglected as depicted in Mohanoe (2013) where people in low skilled jobs in municipalities were doing the same work for 40 years with no options of change and development as opposed to higher skilled level staff in the municipality who have received relatively active professional development. Fourie (2014), researching Expanded Public Works Programmes, also found that where community training is provided, it is fragmented and the training of beneficiaries does not overtly support the creation of learning pathways towards specific green job opportunities; rather the training is very task orientated (focused on handling a chain saw – rather than why they were being trained to cut alien trees or what alien trees were).

Understanding the presence of such a glaring absence in a national system context is critical to provisioning for a green economy and the transformative praxis intent of the study. The absence may also be related to the history of apartheid (section 1.2.2) and a general neglect of worker education. This absence is foundational to enabling access and progression in the environmental sector, and hence focus across levels of skill has an important focus in ensuring that South Africa's post-school education and training systems does not reproduce social disadvantage.

3L: Transitioning to a green economy is not a short term response to achieve the goals of poverty reduction, promoting inclusive economic growth, reducing unemployment, increasing social and environmental justice and equity and promoting greater sustainability. There is a need for a comprehensive system that can examine skills planning for green jobs at all levels of education and training and across a broad range of competencies and fields. The scope of what remains possible is well illustrated by Jagannathan (2013) who presented a useful example, of multi level, multi-stream (basic education; skills, technical education, training; tertiary/ professional education) coordination for education and training planning for green work). In summary, a re-imagined learning pathway system that is transformational in nature, provides learning and makes knowledge available to all people in society.

9.3.1.2 Absenting absences

The absenting process is integral to change. Norrie (2010, p. 29) explained that any process of change can be analysed in terms of absenting or negating an existing state of affairs for a new improved state of affairs. Price (2012b, p. 2) further clarified that whether we are moving from one version of inadequate knowledge to a more adequate version, or from one version of society

to a more adequate version, we are **absenting absences**. Thus, using Norrie and Price's ideas we can explain that better knowledge of environmental learning pathways is advanced by absenting the absences within already-existing knowledge of these pathways (evidence of which is presented in Chapters 6, 7 and 8). Table 9.1 below highlights some of the absenting processes linked to key absences discussed. Presented in illustrative clusters linked to Bhaskar's scalar levels, Table 9.1 points to some of the constraints /ills that underpin the construction of solutions. The second column has clusters for ease of presentation but it should be noted these are interlinked and interrelated and due to this inter-relatedness, they are emergent in different forms at different scalar levels of the real.

Table 9.1: Absenting processes

Bhaskar's levels	Absenting at the level of	Absenting processes ...
The planetary (or cosmological) level concerned with the planet (or cosmos) as a whole	Mega	- Absenting the absence of sustainability as an integral practice and value - Absenting the absence of policy coherence and coordination - Absenting the absence of an interdependent discourse of sustainability, poverty, social and economic development
The mega-level of the analysis of whole traditions and civilisations		
The macro-level orientated to the understanding of the functioning of whole societies or their regions, such as the South African economy in the case of this study	Socio-economic	- Absenting the absence of inclusive, transformative and green economies - Absenting the absence of an intermediate skill economy in environmental sector - Absenting the 'poor value' accorded to intermediate and low skilled entry against the high value accorded to high skill
The meso-level at which we are concerned with the relations between functional roles such as capitalist and worker or MP and citizen	Institutional processes	- Absenting the absence of a proactive approach to skills - Absenting the absence of a comprehensive environmental learning pathway system with multiple entry and exit - Absenting the absence of short-term (immediacy) approach to conceptualising skill needs in the environmental sector - Absenting the absence of low and intermediate pathways - Absenting the absence of adequate information - information gap on entry level and intermediate skills and their clear representation of environmental occupations in OFO and NOPF and the absence of occupational pathways (occupational families and feeder occupations) - Absenting the absence of comprehensive career systems that – promotion if technical and intermediate level work - Absenting the absence of clear articulation between learning and work systems
The micro-level studied, for example, by ethnomethodologists and others	Employer /workplace	Absenting absence of knowledge and information on green jobs. Absenting the absence of workplace mechanisms that can uncover and question employers on green jobs embedded within their supply, value and value adding chains.
The individual or biographical level	Individual	Absenting the belief that environmental jobs are scientific and high skilled
The sub-individual psychological level		Absenting the belief that this is a poor paying sector that only people that are passionate about the environment work in

The absencing processes highlighted in the table above are carried through into the discussion in the next section where the transformative praxis possibilities emerging from the absencing of these absences are discussed further.

9.4 Re-imagining a learning pathway framework for green work

The fourth category of the critical realist dialectic introduced above is **4D** – this enables the re-imagining of a learning pathways system for green work and identifies openings/possibilities for transformative praxis. In the discussion below, I illustrate some of the potential possibilities for change that have emerged from this study. The discussion illustrates and recommends the need for a multi-pronged approach to skills development with a focus on joined-up processes in the environmental sector.

To absent the absences identified above, I propose the following possible actions, as recommendations through which, I argue, it is possible to re-imagine systemically articulated and transformative learning pathways development possibilities for the environmental sector in South Africa:

Recommendation 1: Pro-active skills planning from a base of better labour market information

The analysis presented in this thesis has highlighted the absence of a clear understanding of the complex multi-faceted nature of the environmental sector and the nature of the different jobs needed across the sector (now and in the future) coupled with an understanding of the system that produces and uses environmental professionals (Learning and Work).

The thesis has identified the need for better skills information, as without this labour market information, it is not possible to enable more inclusive skills planning. Having systemic capacity to provide for better labour market information can potentially foster improved understanding of the skills mix (across levels of skills) needed in the sector. This recommendation is strongly supported by the Environmental Sector Skills Plan for South Africa (South Africa. DEA, 2010a). This recommendation also supports a social justice argument for greater access into the environmental sector via a range of pathways and chances. Additionally, it also supports a sustainability argument that more people need to be engaged in environmental concerns in order to counter existing hegemonies of resource management and control proposed in my retroductive argument. This would be inclusive of a more reflexive and open systems approach to labour market analysis, as it is understood that the environmental skills needed today may not be the same as those needed in

the future given the rapidly changing social-ecological context. This may require innovation in labour market intelligence system designs.

Recommendation 2: Skills pyramid resource and job needs of sector

As argued across this thesis, better labour market information has the potential to enable a better understanding of resource needs across levels of skill in the sector – and could enable a better understanding of the nature of green jobs making more explicit what is entailed in jobs, job descriptions, occupational differentiation, scope and level of expected tasks. All of this can enable a better understanding of occupational progression, making learning pathway possibilities more transparent and accessible to learners and workers and managers alike. This understanding of the green work skills mix can potentially also foster better co-ordinated operations across the sector amongst stakeholder groups such as employers, government agencies, professional bodies, and employees.

Recommendation 3: Prioritising multiple pathways

In this thesis I have made a strong access argument for multiple pathways. At the same time, the thesis highlights how these pathway links are structured and how they relate to the production of different types of skill which cannot be disconnected in the emergence of a high-skills sector, if wider transformation goals are to be attained. It is interesting that the environmental sector to date has prioritised high level skilling, with very little attention being given to those systems of skills provisioning that are essential for longer term support and expansion of the high skills base for transformation purposes (HR related), but also wider social-ecological transformation objectives and widespread sustainable development which are high on the agenda of the environmental sector. This is perhaps also related to inadequate education and training or human capital development capacity in the country (South Africa. DEA, 2010a), the newness and rapid growth of the sector (South Africa. DEA, 2010a), and may also be related to the way in which power over natural resources is structured in society (H. Lotz-Sisitka, personal communication, February 15, 2012).

Recommendation 4: Pathways with destinations

As we approach the artisan revolution set to hit South Africa (South Africa. DHET, 2013a) – a multi-pronged approach to skills development with a focus on joined-up processes in the environmental sector is recommended with clearly articulated and programmed attempts to connect low skill programmes to intermediate skills development programmes. The issue “... is not the creation of low-skills work in itself, but how routes out of such work can be created and protected” (Kraak,

2006, p. 37) hence the need for these technical and vocational pathways to connect with existing high skill pathways. Except in the waste sub-sector of the wider environmental sector (South Africa. DEA, 2010b) and the Expanded Public Works Programmes (EPWP) programmes (which provide work opportunities not jobs), there is very little knowledge on artisan, entry-level occupations, and these too are poorly defined in occupational systems and learning pathways development terms (as reported in Chapter 6). In any discussion around entry level provisioning, upskilling and routes out of low-skills work, generations of workers are trapped in low-skills work, as has been found to be the case in, for example, local government environmental practitioner employment in South Africa (Mohano, 2013), due also in part to the problem of wider skills planning neglect in the environmental sector as outlined in this thesis and in the Environmental Sector Skills Plan for South Africa (South Africa. DEA, 2010a).

Recommendation 5: Role of the professional body

In this study, the engineering example has illustrated the role that a professional body can play in enabling transformative potential in a sector. This co-ordinating role can enable the sector to keep an eye on the 'big picture' (sector-wide view) as seen in the engineering case. A professional body can also play a key role in maintaining synergy between the systems of practice and the systems of provisioning and can raise disjuncture and enable bridging, when needed, to maintain quality and standards and enable a proactive approach to skills planning. The environmental scientist example in Chapter 7 illustrated how professionals not linked to professional bodies and professional networks can be disadvantaged. The new NQF Act no. 67 of 2008 foregrounds and gives new credence to the role of professional bodies in skills planning and development. The sector would need to consider the requirements for establishment and recognition of professional bodies under this act. The Act highlights that the professional body, its position and role can become the 'bridge' between the 'different pathways' enabling better systemic articulation. In this process, care should be taken to not only foreground the Green Economy (economic development) aspects of environmental skills and qualifications development, but also the natural resource management and longer term sustainability aspects of environmental skills and qualifications development (i.e. the public good aspects of the sector's work). A Green Economy Skills Planning Forum has recently been established in South Africa considering the former, while an Environmental Sector Skills Planning Forum also exists (considering mainly the latter). These may need to 'come together' for a more co-ordinated approach to environmental sector skills planning in South Africa in future.

Recommendation 6: Role of workplace

As illustrated in the case examples, workplaces have a critical role to play in mediating young graduates into the development of professional competency and to enable and plan proper career pathing for professionals. Enabling progression along pathways, especially at low to intermediate skills, is very reliant on the workplace and diverse and creative mechanisms for workplace learning and human resource development. The study by Mohanoe (2013) identified that aspects such as power relations and access to power and

resources in the workplace, high quality and futures-oriented internal skills planning and Human Resources Management systems, workplace mentoring systems, and visionary management are critical factors for enabling a workplace where learning pathways are opened up, and not simply left absent or neglected.

A further recommendation related to workplaces is the need to support employers so they are able to identify where green work possibilities are reflected in their organisational value chain, and where the possibilities for value addition are, linked to the greening of their work (WP3 of Green Skills Project). If employers are better able to identify and represent green work, they will be better able to represent it in their workplace skills plans and then the quality of information related to green work that filters into SETAs and Sector Skills Plans will be more accurate.

Recommendation 7: Focusing on the whole pipeline

For a mixed skill sector to emerge, there is a need to focus on the whole pipeline – starting at schools, universities, colleges (community, TVET) as well as broader post-school platforms. As discussed in Chapter 6.3., career guidance around non-academic based careers is critical.

Generating public knowledge and interest around diversity of technical and vocational jobs is also critical, as is a recognition of their importance to society and sustainable development.

Finally, the discussion ends with trying to illustrate that system engagement to mediate and support the transformative praxis recommendations of the study is essential. The study findings and recommendations have also fed into the design and development of the Green Skills Project (a project of the National Environmental Skills Planning Forum) which is a systems building project aimed at developing the post-school system to support green skills. The project is thus taking further the recommendations raised in this research. I have recently, through my experiences during this study, also been appointed as a national co-ordinator for this project. This green skill project will act as a catalytic initiative to build the capacity of the national skills development

system in South Africa to pro-actively and strategically produce Green Skills for the Green Economy (<http://greenskills.co.za>).

To synthesise this discussion, Figure 9.2 below provides a quick overview of a re-imagined pathways framework for the environmental sector in South Africa, within a systems wide approach to learning pathways development and actualisation. The diagram provides transformative praxis possibilities focused on strengthening the occupational framework for green work at different skill levels, strengthening information and access opportunities into green work and finally, a more coherent responsive policy environment that prompts better links between skills and environmental policy.

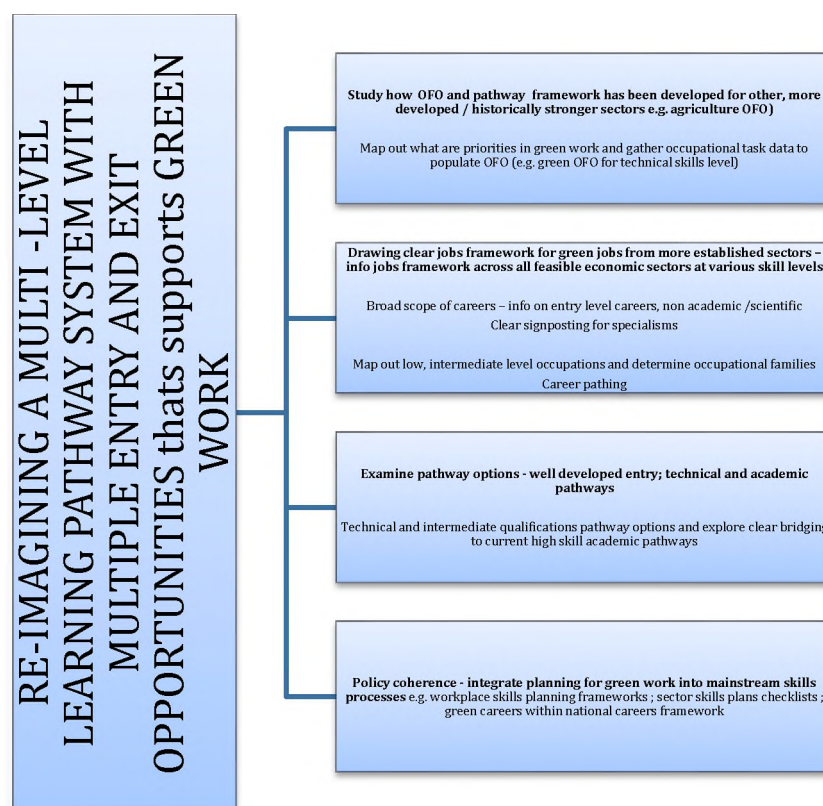


Figure 9.2: Re-imagining a learning pathway framework for Green Work

9.5 Reflections and Limitations

I started this study using mainstream systems thinking which I abandoned along the way as I felt the reliance on empirical knowledge was a limiting factor when the focus was on what was present and on the interrelatedness. This did not provide explanatory or analytical tools to make sense of a system of provisioning that was not overtly visible in mainstream education and training systems and that was largely emergent. The critical realist open laminated system that allows for

emergence and dialectical analysis of being and becoming, as well as literature on learning and work transitioning, both provided a better epistemological and ontological framework for transfactual theories of causality and emergence for environmental learning pathways within a complex and fragmented sector set within open interdependent social-ecological systems. I believe though that further empirical and systemic analysis is needed, especially of qualifications and courses at different levels of skills, of broad labour market demand, of broader systemic analysis of throughput in environmental courses and how it has been changing; all these would all be useful to the growth of the environmental sector in South Africa.

The study's focus on learning pathways created a challenge. With no theoretical or empirical work on environmental learning pathways in South Africa and very little empirical work related to studying the notion of learning pathways, the study had few referents to build on. Additionally, the field of learning pathway research was bifurcated, reflecting micro career story or macro policy level studies with no frames for linking macro and micro. This study has trialled a multi-layered laminated methodology that enabled me to work with micro level careers stories and macro level systemic data in a coherent interconnected way without treating them as oppositional. It thus makes a methodological contribution to learning pathway work and a further contribution to building a research understanding of environmental learning pathways.

An important limiting factor in the development and implementation of this research was the almost total lack of coherent labour market information around environmental work (as it is a cross-cutting issue, there is no assigned skills authority). Hence the research had to construct an evidence base for environmental occupations with no prior baseline data, an evidence base for environmental qualifications, and an evidence base for environmental careers. There was thus no prior baseline for benchmarking, nor were there referents to reflect against, except through interaction and engagement within the field of practice.

The absence of this systemic information hence drove the need to do the work detailed in Chapter 6 in this thesis (studying the system elements that underpin environmental learning pathways), which significantly increased the scope of work of the study and prevented more time being spent on aspects like employer visits and observations in workplaces, which would no doubt have strengthened the study. It could have also enabled more intensive engagement with occupations and perhaps one or two more occupations could have been studied. This is now occurring within the new Green Skills Project, which is building on the findings of this study (discussed below).

On a more positive note, the absence of an informative and clear methodology to study environmental learning pathways prompted a very generative study. I worked very collegially with members of the environmental sector and all levels of data were fed back into the new and emergent processes for environmental skills planning. Hence the study involved reflexive iterative engagement with the field of practice (environmental) and skills development community, where the study was the first academic work to raise questions on the absences for green work within skills planning frameworks and systems in South Africa, building on the problems identified in the ESSP (South Africa. DEA, 2010a) of a reactive, inadequate skills planning response for green skills.

I was able to interact and share insights at seminars at a national level within the South African Qualifications Authority; I led sessions and shared emerging findings within the Human Resources Development network for conservation organisations; gave input into activities of the newly formed Environmental Sector Skills Planning Forum and I was invited to participate in the core occupational task teams for environmental engineer and environmental manager created for government's Strategic Infrastructure Programme that aimed to analyse and design learning pathways for core occupations. The green skills project mentioned earlier is taking further the recommendations raised in this research. All this allowed for a field based resonance and uptake that lends this study significant catalytic validity.

9.6 Resonance of this study

Although this study has largely been a case study of environmental learning pathways in the South African post-school skills system, it is, however, not an isolated entity and the findings could be related to skills systems around the world as illustrated in the discussion below. Through the course of this thesis, green skills emerged as a more dominant way of referring to provisioning for environmental learning pathways, hence the experiences and findings can be seen to resonate with green skills work emerging in various countries, as discussed below.

A first point of resonance for the study can be highlighted in a 2015 report by Rademaekers, Svatikova and Yearwood, 'Facilitating green skills and jobs in developing countries', which emphasises that in developing countries, skills development plays a crucial role to support transition to a green economy and to seize the potential opportunities green growth could present. The study also found that there is "insufficient understanding and addressing of greening skills in developing countries" and thus cautions that the "assumption that greening skills in developing countries is well understood and addressed, and that the labour force is sufficiently

equipped with the correct range of skills, is overstated” (p. 31).

The evidence presented in this study has also illustrated that a disconnection between skills and environmental policies is detrimental for emerging environmental learning pathways and green skills planning. OECD/Cedefop (2014) also highlighted that although skills and employment policies are viewed together and linked, skills and environmental policies are still often dealt with in isolation. Cedefop (2012) further emphasised that there is “limited evidence of ‘mainstreaming’ environmental issues in other policy-making areas”. This illustrates that collaboration between government agencies responsible for environment and education is essential to building green skills transitioning systems. Environment and sustainability issues are by their nature ‘boundary crossing’ and at a broad systems level, they raise questions of articulation and coherence and affect a range of occupations and work practices in different sectors. These occupations are required at all skill levels, and influence all sub-frameworks of the NQF.

Another useful finding of the Rademaekers et al. (2015) report and this study is the acknowledgement of the importance of labour market information and the re-emphasis that quantifying green jobs “remains challenging from the statistical perspective” (p. 39). The report further recommends that one of the most comprehensive approaches was adopted by the US Bureau of Labour Statistics (BLS), which consists of measuring green jobs using two different ways:

i) Jobs in business that produce goods or provide services that benefit the environment or conserve natural resources (outputs), or

ii) Jobs in which worker’s duties involve making their establishment’s production processes more environmentally friendly or use fewer natural resources (processes).

...these two **overlapping elements** implies two different approaches to statistical measurements: an output approach and a process approach. In the **output approach**, ... concerned with jobs related to producing a specific set of goods and services, and is not concerned with the environmental impact of the production process. In the process approach, BLS is concerned with whether the business uses practices or technologies that have a favourable impact on the environment, regardless of the good or service produced. The process approach is relevant to any industry. (pp.39-40)

This example cited from the American Green Jobs programme provides one useful strategy and tool to produce clearer green work data and it would be very useful to take forward these recommendations into the Green Skills Project in South Africa.

Another useful international example to inform future green skills work in South Africa, the ‘Green Economy’ programme developed by the Occupational Information Network (O*NET) under the auspices of the US Department of Labor, offers a more direct approach. O*NET is a database of

occupation-specific information encompassing multiple aspects such as work tasks, education and experience requirements as well as characteristics of the work context (O*NET is a similar but more comprehensive version of the South African OFO) but the work done in O*NET validates the importance of clarifying occupational information, and capturing how work is changing for sectors to use as a guide. The Green Economy programme of O*NET identifies green jobs in three broad groups:

- (i) Existing occupations that are expected to experience significant employment growth due to the greening of the economy (Green Demand);
- (ii) Existing occupations that are expected to undergo significant changes in terms of task content (Green Enhanced Skills); and
- (iii) New occupations that emerge as a response to specific needs of the green economy (Green Emerging).

The strength of the O*NET approach is that it focuses on occupations, which is the natural unit of analysis for the study of employment (Consoli, Marin, Marzucchi & Vona, 2015), which is also a key finding in this study and presents useful guidance for further transformative praxis work in South Africa.

Rafferty and Yu (2009), in the Green Jobs in Australia Report, have highlighted some useful insights as South Africa plans its green skills implementation. This report found “where significant progress has been made in green skilling leadership has been shared between employers and unions” (p. 60). A further useful finding was that much of the initial training demand was met by on-the job training and formal training systems were slow on picking up the demand and evolving course design and curricula needed to be mapped to qualification frameworks, accreditation schemes and industry quality standards.

This PhD research has attracted attention because it adopts a system building approach in its analysis which has the potential to traverse and ‘hone in’ on all or any of the sub-frameworks and sub-system elements (e.g. the NOPF) of the NQF in its framing. Hence the study makes an important methodological contribution **as it illustrates that** it is necessary to understand learning pathways at both the micro career path story level (to understand the complexities and diversity of learning pathways construction) but *at the same time, and linked to the individual career stories*, it is necessary to understand the macro systemic elements influencing learning pathways construction at the micro level.

The study offers case based occupational insights, that highlight a) a re-active approach to skills system development for the environmental sector at a systemic level; b) inadequate

differentiation of environmental / sustainable development occupations; and of sustainable development practice demands within occupations; c) a history of dualism between environment and development (but this is fast disappearing with the advent of the green economy and with the need for climate resilient development); d) various broader issues of poor quality education, social marginalisation, organisational inefficiencies, professionalisation of occupations and work and learning knowledge acquisition patterns.

This thesis has shown that analysing patterns of occupational mobility is a useful lens and is central to understanding how careers unfold. This is significant as it surfaces insights into specialised expertise being developed and access to specialisms is marked by the development of specialised portable skills, knowledge and abilities. Linked to this is the need to support effectively organised and managed networks and groupings of government, employers, workers and providers of training and education across industry can facilitate the exchange of information. OECD/Cedefop (2014, p. 40) claimed “given that green activities do not fit neatly within traditional sectoral boundaries, better co-ordination is also called for to analyse and monitor developments across sectors and occupations”.

A further insight useful for understanding the emergence of sustainable development occupation learning pathways, and for learning pathways research, is that serious policy attention should be given at national government level to raising awareness of careers possibilities through existing national information, advice and guidance systems. This also needs to be coupled with suitable signposting to enable young people without the requisite STEM qualifications to have ‘second chance’ access to them, possibly while gaining some of the practical experience which is valued by employer (Cedefop, 2012, p. 116).

A recent study undertaken across seven European Union countries (Cedefop, 2012) shows *very similar patterns of transition systemic development*, as those shown in this research. I cite from the introduction to this report to show the similarities with the current situation in South Africa:

... In many Member States this shift is already under way and new green occupations are emerging. Many expect that green technologies and practices will come to pervade the economy. The green economy significantly affects labour demand, education, skills, occupations and the geographical distribution of jobs and workers. Yet we know little about how this trend affects the demand for skills and the provision of education and training ... there are ... positive trends in providers’ and employers’ attitudes towards the development of the green economy and its implication for skills and training activities. But there is also an uncertain and fragmented picture of both policy coordination and stakeholders’ cooperation. Uncertainty about environmental regulations and policies makes it difficult to anticipate skill needs; multiple entry routes and insufficient recognition of skills acquired through non-formal or informal learning tend to deter workers from

transferring to green jobs; learning providers are not sufficiently active in anticipating demand and are discouraged by uncertain and diverse employer needs. ... In these circumstances, policymakers, the social partners and training providers need to work closely together to ensure a consistent policy framework that can promote future investment in the green economy. The aim should be to improve recognition of green skills, making it easier for people to apply them to new jobs, new workplaces or new regions. (Cedefop, 2012, foreword)

9.7 Recommendations for further research

Emerging from the work of this thesis I would recommend the following areas for further research:

- Further work on developing coherent research methodologies to study emergent green work is needed. Linked to this is the need for research on how to determine occupational demand with a futures perspective, especially within the unfolding contexts complex transitioning societies.
- Research on environmental occupations, especially at employer workplace levels, is needed. This I believe will enable South Africa to build a more coherent understanding of entry and intermediate levels work, the vocational streams linked to these jobs and how they can inform and influence the OFO and how we plan better occupational qualifications for green work.
- Linked to occupational research related to green jobs, is the question of whether learning pathways are shaped by the regulation of occupations (as seen in engineering) and whether this regulation / non-regulation shapes the structure of the occupation and hence becomes a distinguishing feature of the learning pathway development.
- Within career development research, further empirical research on how people gain access to specialisms (with a focus beyond first job) would help to build this empirical picture and help us to improve career systems within universities and TVET colleges and explore how career development with graduates needs to be supported.
- The role of professional networks and their capacity to enable professional learning was an important emergent theme across both occupational chapters that need more careful and systematic research.
- Research on how projectification of environmental work as seen in the case examples and

understanding the emergence of non-institutional based environmental learning pathways.

- Further systemic comparative research on green skills system building as a phenomenon of transitioning societies (e.g. international comparative research; Cedefop (2012) type study in African countries/developing country contexts) as the main comparative referents at present are more developed country contexts.

9.8 Conclusion

I began this thesis with the contention that learning pathways for environmental jobs needed more careful investigation with the rapidly emerging discourse of green jobs and based on the 2010 DEA findings of a reactive system of skills planning that has left South Africa with inadequate information on environmental learning pathway development. As there had been no empirical work in South Africa on learning pathways and no work investigating what this could mean within a framework of transitioning jobs within a transitioning socio-ecological systems, this has been, I believe, a study that can potentially catalyse further work as South Africa develops clearer frameworks for studying different aspects of green work.

Throughout this thesis I have tried to illustrate that failure to see learning pathways as a complex phenomenon would entail disregarding the multi-effect influences of activities in open systems and disregarding multiplicity of causes influencing stages and events (Naess, p.73)

In conclusion, I believe the study has provided the following contributions. At a **theoretical** level, the study has shown that environmental learning pathways need to be viewed as a complex phenomenon that is emergent in open systems. A deeper understanding of learning pathways is driven by both educational and occupational progression. This study has further identified green skills as an important focus in research work on transitioning societies.

At a **methodological** level, the study has shown how macro-micro and laminated system research can be useful in studying transitioning systems. As a laminated systems study with a focus on transitioning societies, it provides a baseline for further systems study on green work and green skills.

At a **practical** level, the study has made actual contributions to building and informing future developments in the South African post-school system and to informing developments in the Green Skills project.

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APPENDICES

Appendix A: Interview Schedule

Appendix B: Extract of story from EE2

Appendix C: Mobility patterns of all nine interviewees

INTERVIEW SCHEDULE: LEARNING PATHWAYS: ENGINEERS

To guide semi-structured interviews – allow people to tell their ‘story’

LEARNING PATHWAY:

A) SCHOOLING:

- Reflecting on your childhood and schooling; are there any Interest /opportunities/other factors that influenced you (or played a role) in your final career choice (*probe for school influences that may have influenced career choices*)
- Subject selections done in high school – Which subjects did you do? Why did you select them? Factors that influenced your subject choices? (*probe if career direction / or interest in environment was a factor in selecting subjects*)

B) POST SCHOOL:

➤ Higher Education

- What primary qualification /undergraduate qualification did you do? Why did you select this? Which Subjects did you do? (*probe if career direction was a factor in selecting subjects*)
- Reflections on your experience of the undergrad qualification – *positive and negative factors (enablers and constraints) that influenced university education ..*

➤ Postgraduate:

- Do you have a postgraduate qualification?
- What postgraduate qualifications did you do?
- What were your reasons for selecting this PG qualification (if this was done linked to a JOB - *probe what was the need/gap in JOB skills if there was one*)?
- Reflections on your experience of the postgraduate qualification – positive and negative factors (enablers and constraints) that influenced you..

C) CAREER PATHWAY IN WORKPLACE:

- Thinking about your first job to the present – (if applicable) Can you describe your working (career) route to your current job? (*for each job move, probe factors +/-that influenced moves*) *from first job to present – try to capture job roles/ workplaces/tyoes of work*)
- *What was your first job? Where?*
- What are some of the challenges you have faced along your career route (both academic and in the workplace)?
- How did you gain information about an envrionemntal specialism? / developed interest to enter environmnetal sector – seek trigger factors.
- How long has it taken you to settle into an environmental specialisation? Seek what enabled access into specialism.

D) TRAINING IN WORKPLACES:

- Are sustainability practices included in your options for workplace training? Who pays – line-function? Most useful course/training?
- Has it been difficult to find needed training?
- Have you ever had a mentor? Who? Why? Use of mentoring?

E) CURRENT JOB:

- What Sustainable Development practices are you involved in now?
- What environmental skills do one need for these practices?

ADVICE TO NEW ENTRANTS INTO SECTOR:

- How can we encourage engineers to specialise in Green environmental engineering?
- Which would you recommend as the best route into a job as yours (*probe educational choices and job choices*) today?

Appendix B: Extract of story from EE2

INTERVIEW NOTES - EE2 – 01-02-2013

Career stories were then developed from Interviews and CVs

I went to an ordinary model c school. I did typical science subjects, I had biology natural sciences and geography, if there was one subject I would say was catalyst significant in the choosing of my career, I would say it was geography rather than maths and science and biology to a little extent.

So i can say geography as it was taught then was the main catalyst for me ending in the environmental field. Broad coverage -physical geog, weather and climate the fact that you could actually see all of the theories outside the school or car window was really the thing that sparked my interest in the environmental field.

Environmental sciences wasn't really a thing when i was in school. When i was in school it never struck me to become an environmental scientist, I just think that the fact that i had biology and I really enjoyed it as sort of a support to that.my interest was not significant but it was supported by a general understanding of biology and am not really a terrible nature lover, but am actually more of someone who likes to plan things correctly.

When I was in my matric year I had to go into a field associated with geography largely, but I had this nagging thing in me that I really enjoyed the built environment as well as architecture and things like that. i realised that I need to plan things so that its right. –getting the right solution – environmental issues and design and develop issues – thought about town planning then i discovered through an expo about landscape architecture and read a lot about that and at that stage landscape architecture had already been started in south africa. Only profession working with environmental impact assessment – first profession to do it.. [REDACTED] work issues ...

It was based on [REDACTED] work an american.I visited one of the offices – busy with environmental type work - this is where i want to be and realised that's where i wanted to be so I did a 4 year degree in landscape architecture at the University of Pretoria. – They were the only university at that stage to offer that course. Currently also UCT has a masters deg no undergrad...

From there I got a bursary with the department of water affairs after first year and when I finished my studies i started working for the department of water affairs as technician..

They had a unit called the special task (didn't know what to do with environmental people) and we actually developed a whole new way of thinking because the water affairs had many engineers in it who had a lot of depth and skills and we were just slowly but surely growing a whole new sense of environmental awareness .

DWA really strong department -

We were mainly asked by engineers to do rehabilitation, - fixing up after they have been there so we did a lot of landscaping but not in garden context where we rehabilitated a lot of areas -

In my studies we had a lot of horticulture which was for two years, it also included geography. the syllabus has changed much over the years, but in those days we had an in-depth knowledge of the subjects.

We eventually got involved earlier in projects to try and change their planning so that we had the less problems at the end of the day trying to fix up scars.

We developed a whole process of planned projects. Senior high level environ screening associated worth planning; as they moved down involved more we also involved environmental assessment levels to that in 1988 when i left we had actually done amazing work,

We did a dam in free state –rock painting overhang that would have been submerged ; rescued rock paintings – exhibit in museum, wonderful success stories we also had a massive revegetation exercise at a addo national park. – additional areas for buffalo to play - massive rehabilitation exercise – wont believe today that was there before all success stories which gave env work in DWA a profile..

I realised i had to become a private consultant, i joined an engineering firm and we did a lot of work in the cape in various developmental areas –armscor; testing range in arniston – pre all legislated EIA - there was certain principal decisions that made by the armscor the management decide to do more WORLDCLASS work - had to do ... EIA and we did quite exciting work...

from there I went for about six years where i got involved on the Lesotho highlands water project under phase 1a and phase 1b. phase 1a was more of an onsite environmental experience totally new site based environmental staff – day to day running of a project-

We had to ensure that things were done right from an environmental perspective – we did an EIA prior also we built the whole eca system and it required a lot of monitoring. Did EIA for Mohanle tunnel which was phase 1B and 10 years later did EIA for 2nd phase which will start soon.....- i was still working there and its been a long involvement in lesotho and after that i went back to joburg.i became office based and started building a team up til then almost always on my own – building office of environmentalists.

I left that firm thereafter, At that point I joined [REDACTED] at that point i was basically on my own built the env region in the gauteng region, they only had one in cape town. We also built it as a unit where we were doing international work from and we merged with other [REDACTED]. i was leading the environmental team for Africa and we started building that team in joburg, - started with 2 now have a team of around 55. Work through country .

I am also currently the environmental service line leader for [REDACTED] globally ...align resources from Australia; New Zealand ... in africa..

That's in a nutshell basically how my career developed and I think the time I decided to do landscape architecture the thing that drew me there was not so much trying to be an environmentalist, but I wanted to be part of a design team so that I can make a difference and that was the only thing driving me.....it just grew and I think in terms of professional growth you need to have a diverse sort of experiences when you are a junior person. I think water affairs was fantastic, they were at that stage doing massive construction and they did all of their dams on their own, didn't use outside contractors ..so they was this massive earth moving and i gained experience and understanding on what construction and earth moving was all about....costs involved the thing is you need to have a clear understanding of all these things and you need to have an intervention and minimise your damage so you don't have to come back in the end and re-shape – that was important and the Lesotho experience be on a site – lonely but the buck stops there. ..one a site – construction happening everywhere and they come to you ask can we do this???? Research quickly – before computers ... find right answer, that was vital and I think that period was when you needed to take responsibility and make decisions as the construction was going all over. you also needed to research quickly and find the right answers and then actually be able to defend your answers to the engineers and ensure that they implement it....it was probably the most important learning experience that I had which shaped my career.

When I look back at my career I can only say I have been extremely lucky,I spent 3 yrs as an environmental manager at [REDACTED] greenfield steel plant R6 billion – project team selected ---built a steel plant in 3 years where there was a very challenging project and there we had to master how not to work ourselves to death. Different framework – make different turnkey contractors responsible environ.. it was an extreme learning experience, also throughout my career

Throughout my career I have been doing international work throughout my career and that's also a different part of learning experience, because apart from being exposed to standards of work and financial corporations like World Bank, you see different places and how different environments are being affected. I have worked in places like Mauritius, Mozambique, Algeria, Sudan, Angola, Malawi, Swaziland ; Abu Dhabi e.t.c. – worked all over

It's also about working hard to gain the skills it's not something that will come to you and you need to find the opportunity, seize it, sometimes difficult like living in Lesotho was but find the learning opportunities there... to see what you can do with your career and live with it.... It's tough sometimes – work 6 days a week... but you need to do that ..

Because there are so many avenues to becoming an environmentalist - I can say it's not easy to find a career path, but the elements that I was exposed to being on site ; construction for a long time and understanding all of that and also being part of a big organisation like water affairs at that stage – understanding how by small changes we can start making changes,,, when you have small wins built environmental skills and – live with it work with it

Didn't do PG; I did a degree in town planning and have also done a number of short courses. I am very active in our institute and am currently on board of control.

As a landscape architect – requirement to do PD - I keep my PD points updated and have always been active in my field and in my professional society... I think it's important to be active –if you are a professional req. for you to be there – need to be there and make your mark there as well I also did environmental law, environmental assessment methodology,, people write long descriptive reports about impacts but with little methodology – so it doesn't allow some-else to arrive at the same /similar conclusion... specifically realised gap in all training... done weird and wonderful things not all related to work... – focused on that have also been involved in the chamber of mines in Lesotho concentrating on noise and air quality. – gave me an opportunity extend EIA work – broaden out understand specialist fields...

I faced a few challenges, at Water affairs but the real challenge was to bring environmental awareness up to a level where the senior management of the department saw the benefits in dealing with environmental issues on the onset of projects and understanding that you need to have an ongoing process of environmental assessments at different levels with your whole planning department they planning development all over – they need multicriteria analysis of an option – if there are five options - best solution – deals with env. Issues as well.....you actually need to involve environmental people in as far as supplying water is concerned .the best solutions also deal with the environment and that was a big challenge coz at that stage in 1984 - team at water affairs all landscape architects BTW.. only a few good people asked about the environment.

The other big challenge was earlier on in my life I took a decision that if I was really to be involved in the big projects and make a difference I needed to be in a large engineering firm, there was no point being in a small environmental firm of 3 or 4 people and think you can make a difference. I have different opinions and I think I needed to be in an engineering firm....the real challenge there was growing and becoming a director standing at the same level as an engineer would....showing them just as much understanding of business and going forward – as any of the engineer that has been a challenge ---

The ongoing challenge is really building an effective team where you have happy people meeting everyone's wishes and expectations in terms of careers and the sort of work they want to do that's my real challenge (managing teams). My approach to putting a team together usually I employ the right human capital rather than trying to stopfill holes gaps – employ people for projects... it's difficult coz sometime you have to carry people for months don't have work for them they also I am that kind of person who knows that the work will come and you must just have the right resources. ... you can present yourself to

the client – see we have the resources...sometimes the workers get frustrated coz the work is not there yet but it eventually comes...

My team is diverse, I have 2 landscape architects and they come from the same planning holistic district picture background. I also have people with BSc science background degree, - logical I have only one person with a geography background, I don't know why that is maybe I was just unlucky with finding people with a geography background. I have a few social sciences people- social impact assessment I also have a person with journalism for public meetings and presentations – biggest BSc – primary water sciences, botany zoo; environ science;... I also have one guy in our CT offices who is an environmental engineer did a PG in EE ...(in SA which is mostly water treatment or waste orientated municipal oriented and about water treatment than dealing with bigger environmental issues) in America – SA degrees - its emerged that way cause it was sort of a specialisation to differentiate btwn the engineers.... EE is waste water treatment; really focused rather than bigger issues ...historic link – wits started – type of specialisation to differentiate civil -

I am not a member of ECSA – SA council for LA but I push all my BSc people to register as (Pr SATNASP) soon as possible, because that's important I do believe in professional registration. I think the IAIA is going to take time to set up.....needs to find a home in one of the departments that have registration, unless they move to the ministry with skills able to administer a prof body --- if public works they are going to have a very difficult time. All the other professional bodies have an act of their own to govern professional registration. all the engineers and architects have to register with the department of public works. IAIA try to build on one aspect in NEMA – all other have a act to govern their admin.....

I just think IRA is a voluntary association which needs professional registration. I am also pushing hard for professional registration for environmentalists to be actually accessible by people from a social science background.

I had two people I regarded as mentors, one a landscape architect prof in private pract... worked with during my student days and his name was [REDACTED]. I actually kept in contact with him until he died. I used to chat with him and share my views with him. the other one was an engineer, but at that time was more of just a manager – [REDACTED] - and I was also directed to him.....he taught me on general management skills , gen negotiations skills while [REDACTED] was more into technical mentor...

The specialist fields difficult to go further into like air quality; noise and vibration are not easy to go further into. I think most of the specialists have evolved in that field. Don't have much skills I also feel environmental planning as a major discipline has also been neglected,,,,, get guys from BSc background – don't look wider with the demise of geography in schools we have lost a lot of people who could potentially go into the field. ...

Appendix C: Mobility patterns of all nine interviewees

Patterns of Mobility – Engineers

The table presents data related to job moves of interviewees in an effort to gain a deeper understanding of the data. The table provide some insight into career history.

Numerous Inter and Intra organisational job moves are evident across all stories. In early careers (candidacy period) Internal upward movement is depicted in EE1; EE2 ;EE3; EE5 and EE7.

A break in employment and periods of unemployment was displayed only by EE4 and EE6. Both experienced a period of unemployment before entering job market. EE 4 was very stable once he eventually got a job after 8 months but EE6

Mobility patterns in EE2; EE4; EE5; EE6 and EE7 reflects frequent job moves between two organisational types – **engineering consultancies and environmental consultancies – visible occupational and organisational change – access to specialisms**

Depictions of work role transitions in all stories to facilitate the development of specialist competencies.

Breaks in employment and periods of unemployment was displayed only by EE4 and EE6.

	During study	After university						
		1	2	3	4	5	6	7
EE1	Worked in civil engineering consultancy – vacation work	Engineering Consultancy: Trainee Civil Technician / Junior Civil Technician / Civil Engineering Technician	Engineering Consultancy: Senior Engineering Technician & IT Manager	Engineering Consultancy: Civil Engineering Technician / <i>Environmental role within firm (driven through prof. networks)</i>	Head of Green Building and Sustainability Services Lead at Professional body –green building			
		1- Mobility pattern depicts internal upward movement – Ng et al 2007 2-Then External upward movement; 3-Then External lateral movement						

		Work role transition depicted change in job content – crafting of a new work role for himself this could be viewed as occupational change within the mobility construct.						
EE2	Landscape Architects and Environmental Planners Vacation work	Department of Water Affairs Special Tasks Division Technician Design Services Division – Landscape Architect	Houwteq Environmental consultancy Environmental Officer	Engineering Consultancy Landscape Architect Associate	Environmental Consultancy Associate Senior Associate Director	Engineering Consultancy Director – head of environmental division Competency Leader for Environmental Works - Africa and Middle East regional team		
		Initial Mobility pattern depicts internal upward movement. External lateral movement into organisation that enabled occupational change. External lateral movement that enabled him to move back into an engineering company. External upward movement that enables occupational change. Mobility pattern reflects an individual that makes frequent job moves between two occupations – visible occupational and organisational change. Example - depiction of crafting						
EE3	Worked at civil engineering consultancy and large environmental consulting firm	Small Engineering consultancy – candidate engineer Engineering consultant (saw gap and formed	Large engineering consultancy -	Moved UK – join large company with specialist water and wastewater – led Design Engineer	Back to SA – joined engineering consultancy Senior Engineer Principal			

		the water and waste water)			Engineer – water and wastewater			
		Initial internal upward mobility – work role transitioning and task enrichment as he identified gap and moved into developing that area of competence for himself. External upward mobility as he moved to larger firm. External lateral mobility – to enable him to specialise and develop specialist skills – selection of organisation based on their specialist water and waste-water work. Work role transitioning – as he moved again into a company that would allow home to be a specialist – then internal upward movement.						
EE4	Worked during masters – ran an environmental course at he university. Vac Work at Envirochem	<u>Waited 8 months</u> after masters to get a job. Eventually left Cape Town and moved Johannesburg.	Engineering Consultancy – Chemical Engineer waste management unit	Environmental consultancy – Environmental Engineer	Environmental - Energy Services Consultancy - Environmental Engineer(Energy)			
EE5		Department of Water Affairs Engineer in training	 Engineer Senior Engineer	Engineering Consultancy Environmental Engineer	Environmental Consultancy Director	Engineering Consultancy Director	Engineering Consultancy Divisional Operations manager Group Leader	Independent Environmental consultant
		Pattern of mobility internal-external upward and lateral movement. Across two occupational areas. Depictions of work role transitions to enable the development of specialist competence						
EE6	During Post-graduate: Researcher – technical advisor –	Engineering Consultancy - Environmental Scientist (2 years)	Worked at Solicitor in UK- Researcher, Web Designer, IT Service	Attorneys Office – Researcher Tender Writer	African Centre for Biosafety Researcher, Report Writing, Biosafety	Financial Sector Charter Council, South Africa Researcher,	Engineering Consultancy Consultant – Waste management	Engineering Consultancy Associate Director – Waste

	monitor and advise on landfill operations	Process Engineer	Provider		Analyses	Report Writer, BEE Ratings Determinations		
		Definitely non linear!!! Mobility patterns depict job changes and shifts in occupations.						
EE7		Engineering Consultancy Design Engineer	Engineering Consultancy Resident Engineer	Engineering Consultancy Environmental Engineer and Auditor	Environmental Consultancy Associate	Engineering Consultancy Environmental Engineer and Auditor Associate		