ANALYSIS OF A FOUNDATIONAL BIOMEDICAL CURRICULUM: EXPLORING CUMULATIVE KNOWLEDGE-BUILDING IN THE REHABILITATIVE HEALTH PROFESSIONS

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ANALYSIS OF A FOUNDATIONAL BIOMEDICAL CURRICULUM: EXPLORING CUMULATIVE KNOWLEDGE-BUILDING IN THE REHABILITATIVE HEALTH PROFESSIONS

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ABSTRACT

This study was motivated by the researcher's experience that students in the rehabilitative health professional programmes were finding it difficult to access fundamental knowledge upon which their professional practices and clinical contexts are based. An important focus of the research was the extent to which cumulative knowledge-building was impacted after the foundational biomedical curriculum became an interdisciplinary programme. The study explored whether the organisation of the interdisciplinary foundational curriculum served the fundamental needs of the professions, and whether, as a matter of social justice, students' access to powerful knowledge was enabled by the form that the fundamental curriculum assumed.

This curriculum study at a particular Faculty of Health Sciences foregrounds the structuring, organisation and differentiation of disciplinary knowledge, and reflects a twenty year period that included not only transitions in professional education but also extensive transformation in, and a different approach to, health delivery. At the institution, physiology and anatomy, the biomedical sciences basic to the health professions, underwent disciplinary merging and subsequent altered positioning in curricula. Medicine opted for a problem-based learning approach whereas the rehabilitation health sciences did not. Legitimation Code Theory (LCT) provided the means for analysis of the extent to which interdisciplinary organisation in the foundational curriculum for Physiotherapy and Occupational Therapy enabled integrative, cumulative building of knowledge for professional and clinical contexts.

Specialisation and Semantics dimensions of Legitimation Code Theory were used to reveal the principles underpinning practices, contexts and dispositions of Anatomy and Physiology at the Faculty of Health Sciences over a twenty year period post democratisation in South Africa (1994 – 2013). Disciplinary positioning in curriculum prior- and post-merger, were compared and contrasted. LCT were used to characterise the distinctiveness of Physiotherapy and Occupational Therapy at the university including the kind of knowledge and the kind of knower that specialises the different professions, and what is valorised and legitimated for each kind of professional.

Semantic gravity was used to explore the expected knowledge recontextualisations in diverse and complex clinical settings for each of the professions. Registered professionals who are clinical educators as well as curriculum designers for clinical studies were interviewed. Profession-specific course outlines were further data sources.

The biomedical disciplines Anatomy and Physiology were characterised for their measures of distinction and their respective knowledge-knower structures. Analysis traced each discipline from its strongly classified form in autonomous curricula when there were separate learner-cohorts for physiotherapists and occupational therapists, to post-merger when the disciplines were framed as human biology in an integrated foundational curriculum for a joint cohort of students.

Curricular documents for the twenty year period were analysed quantitatively and qualitatively to establish the positioning of Physiology and Anatomy before and after the disciplines merged to a single course of Human Biology. Teaching staff were interviewed for their understanding of what specialises the physiological and anatomical components of the Human Biology curriculum, what they considered as powerful knowledge for the professions, and who they envisaged as the ideal student-knower exiting the basic sciences platform to enter more advanced clinical studies. The degree of context-dependence for meaning-making in the different disciplinary domains and the condensation of meanings inherent in the respective practices and contexts, were analysed.

The thesis argues that following the merger Anatomy is preferentially legitimated as powerful knowledge at the expense of Physiology; that the ideal of disciplinary integration is not reached, and that the segmental organisation and structuring of the curriculum negatively impacted on cumulative knowledge-building and application of professional knowledge in the clinical arena. After the merger the disciplines lost their shape, and in particular the hierarchical knowledge structure of Physiology collapsed. By not having access to the necessary disciplinary knowledge structures and their associated practices, students' ability for scaffolding and integrating knowledge into the clinical arena was constrained. The organisation of the current Human Biology curriculum does not facilitate cumulative learning, and in so doing may not contribute to

the envisaged graduate professional who is required to practice within a complex and demanding healthcare work environment.

The significance of this study conveys that interdisciplinary programmes should be carefully considered, and there is an added imperative in the health professions which ultimately realise treatment of patients. If, aside from interdisciplinary teaching, there are also merged cohorts of participant students, then a sound understanding of the epistemic requirements of each profession is required. Those involved in curriculum development in various fields need to take these recommendations into account to enable cumulative learning and enable epistemological access to powerful knowledge for an increasingly diverse student body.

Key words: curriculum, physiology, anatomy, human biology, occupational therapy, physiotherapy, epistemological access, Legitimation Code Theory, professional knowledge, cumulative learning, knowledge-building, segmental organisation.

DECLARATION

I declare that the dissertation / thesis entitled, ANALYSIS OF A FOUNDATIONAL BIOMEDICAL CURRICULUM: EXPLORING CUMULATIVE KNOWLEDGE-BUILDING IN THE REHABILITATIVE HEALTH PROFESSIONS, which I hereby submit for the degree, Doctorate of Philosophy of Education at Rhodes University, is my own work. I also declare that this dissertation / thesis has not previously been submitted by me for a degree at this or any other tertiary institution and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

SIGNED: 

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Dedicated to my sister Britt, a wise and gentle soul, who always got me, who always was beside me, and who forever will be with me. My mother, a remarkable woman whose indomitable spirit and life force will guide me for the rest of days - this too for you with much love. Mme Maria ke ya leboha aholo. Brothers Jacques and Mark who have steadfastly encouraged from afar, hope this makes you proud. Thanks to my aunt Janet for her quiet encouragement - Peter and Averil too. Luke, a very special friend, whom I count as family … we share bonds which never will be broken … *salute'* with a glass of merlot to the three of us.

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ABBREVIATIONS

CHE – Council on Higher Education

CHERTL - Centre for Higher Education Research, Teaching and Learning

CPD – continuing professional development

CSP – Chartered Society of Physiotherapy

DOE – Department of Education

DOH - Department of Health

EPD – Epistemic Pedagogic Device

ER - epistemic relations

FHB – Faculty handbook

GSH – Groote Schuur Hospital

HE – higher education

HEI - Higher Education Institutions

HIV – Human Immunodeficiency Virus

HPCSA – Health Professions Council of South Africa

HUB – Human Biology course or Human Biology course code

HRS – Health and Rehabilitation Sciences

KZN – Kwa-Zulu Natal (region on the eastern seaboard of South Africa)

Lab – laboratory

LCT – Legitimation Code Theory

MBChB - Bachelor of Medicine and Bachelor of Surgery

NRF – National Research Foundation

OT –occupational therapy or occupational therapist

PBL – problem based learning

PD – Pedagogic Device

Prac(s) – practical(s)

PMB – Physiology and Medical Biochemistry (course)

PT – physiotherapy or physiotherapist

RU – Rhodes University

SA – South Africa

SAAOT – South African Association of Occupational Therapy

SAMDC – South African Medical and Dental Council

SASP – South African Society of Physiotherapy

SG – semantic gravity

SD – semantic density

SR – social relations

TB – Tuberculosis

TLA – teaching, learning and assessment

UCT – University of Cape Town

UK – United Kingdom

WHO – World Health Organisation

CHAPTER 1. INTRODUCTION — STUDY BACKGROUND, RATIONALE AND RESEARCH QUESTIONS

We live in an era of exponential growth of new knowledge in the medical, science, and technology fields. There is not only a democratic imperative for equitable access to the practices of higher education, there is also a need in these rapidly changing times to graduate professionals who can respond to increasingly complex social, societal and professional demands. Universities are under considerable pressure to ensure curricula which are responsive to these multiple demands, while further research is required to interrogate the ways in which knowledge is structured in such curricula in order to enable the graduation of professionals who are equipped to meet the complex requirements of the workplace. This particular study looks at a biomedical curriculum as the fundamental knowledge for the rehabilitation professions of physiotherapy and occupational therapy.

1.1 Background to the study

My study spans the period 1994 to 2013 which mirrors the first two decades of democratisation of the higher education sector in South Africa. The new democracy also heralded a new approach to healthcare, and consequently expected more responsibilities and expanded roles of its healthcare practitioners. The focus of my research is twofold: firstly there is an analytical focus on a foundational curriculum for health and rehabilitation practitioners which underwent a merger of the traditional biomedical disciplines of anatomy and physiology during this period; secondly there is a focus on the rehabilitative health professions physiotherapy and occupational therapy and what they require of the fundamental curriculum for their respective professional knowledge practices. My study therefore is embedded in sectors which have undergone massive changes and in this chapter I discuss both the higher education context and the primary health care model (PHC) as background to the study.

In the higher education context the transition from our apartheid past has meant, amongst many other issues, increased admissions to those social groups previously denied formal access to the university. Consequently this has expanded classes of socially, culturally and linguistically diverse students who bring with them a range of

socioeconomic and familial circumstances, and differential educational backgrounds arising from a highly unequal schooling system (Scott et al 2007, Scott 2009, Bitzer 2010, McKenna 2016). However, only about 10% of black youth are entering higher education, meaning that white and black students still live in 'different worlds of opportunity' (McKenna 2016, p145). Success and throughput rates need to be drastically improved especially for the historically disadvantaged groups. This makes it important to understand how we can improve students' access to powerful knowledge that is offered by universities.

Widened access to the university has not necessarily meant access to, and increased participation in disciplinary knowledge practices – a concept known as epistemological access (Morrow 2009). Increased admissions have also not necessarily meant that students are enabled to succeed in the university, or acquire the ways of knowing that are necessary for professional practice (CHE 2016). To the contrary, higher education is still generally characterised by extended time to qualification, high levels of attrition (McKenna 2016) with 'insufficient capacity for adequate skills production' (Cloete 2016, p3). My research is especially focussed on issues of epistemological access and the ways in which curriculum organisation may enable or constrain such access.

My investigation is part of a collective research effort co-ordinated by the Centre for Higher Education Research, Teaching and Learning (CHERTL) at Rhodes University to research 'social inclusion in higher education' (NRF Grant 73998). The NRF-funded project has supported a number of PhD scholars to study the issue of epistemological access to different kinds of knowledge across different disciplinary homes and differentiated institutional types. Multiple studies were undertaken using a broadly pre-determined theoretical framework with a shared central concern: How do disciplinary knowledge and knower structures and their associated practices serve to include or exclude students? Multiple theses meant that broader conclusions could be reached in attempts to attain systemic relevance. My study explores the medical sciences and professional knowledge and looks at ways that curriculum practices may constrain epistemological access, and how students may be excluded from good quality learning.

Access, inclusion, participation, and equity are tenets of a democratised system which has social justice as the chief objective. When apartheid ended, original policy discourse centred on 'transformation' which would redress past inequalities and meet the new democracy's goals of reconstruction and development (DOE 1997). The National Commission on Higher Education which was set up by President Mandela (and which released the White Paper 3 in 1997), reported that outputs of the Higher Education system did not always match the needs of a new economy to remain relevant, competitive and marketable and they attributed this to a shortage of graduates in Science, Technology and Engineering where discriminatory practices had impacted especially blacks and women. Aligned with global trends, South African Higher Education Policies also promoted transferability of knowledge and curriculum renewal (Allais 2007, 2012, Ensor 1998, 2003, CHE Review 2016). Academic insularity and closed disciplinary programmes were seen as problematic to the needs of a modernising economy (DOE 1997) and there were shifts to interdisciplinary research and to interdisciplinary and multiprofessional teaching alongside institutional and departmental re-structuring (Fourie 1999, Lange and Luescher-Mamashela 2016, CHE review 2016). Embedded in concepts of transformation, access, differentiated knowledges, knowledge-building, and forms of curriculum, are constellations of meanings and understandings which are central to my project and I comprehensively expand all of these in a dedicated conceptual chapter (see Chapter 3 - Conceptual Framework).

Consistent with restructuring trends and moves away from pure disciplinary teaching, there emerged at the site where this research takes place (a Faculty of Health Sciences), an interdisciplinary programme of Human Biology the purpose of which was to establish a foundational programme for rehabilitative health professionals. Transformation framed both the approach to (health) education as well as to healthcare. When a National Health Plan was revealed by the new government of 1994 it reinforced the primary health care model (PHC[1]) which governs the clinical training and service environment of physiotherapists and occupational therapists.

[1] PHC approach has ideological/historical links with South Africa by way of the Pholela model which was generated by a group of doctors working in rural KwaZulu-Natal (1940 - 1970) who envisaged that health care be afforded to all according to needs and not to means. This model set out socially acceptable holistic health care incorporating health education and promotion (immunisations, school feeding schemes, food gardens, baby food supplementation), and provided preventative and curative health services in a community-based package (Kautzky and Tollman, 2008).

During apartheid, health care was determined by income, race, and location; health services were racially segregated and also highly fragmented within public health, and between the public and private sectors. At this time (in South Africa as well as globally) there was expansion of costly hospital-based curative care which served the elite without adequate preventative and basic health care for the majority (Kautzky and Tollman 2008). The Primary Health Care approach was endorsed in 1978 at an international conference on primary health care in Alma Ata (in the previous USSR) signifying revolution in healthcare globally (WHO Report 1978). The Alma Ata Accord failed to affect isolated South Africa, until the National Health Plan was instituted in 1994 which restructured the health system (Kautzky and Tollman 2008).

The primary health care approach embodies a philosophy of prevention, promotion, cure and rehabilitation. It is inherently egalitarian and pro-poor and frames health as a universal human right. Levels of service are apportioned so that primary health care facilities are the first port of call and referral to specialised secondary/tertiary level health care arises from the primary source (WHO Report 1978). Post-apartheid reform was complicated by high emigration of medical doctors and severe shortages of health care workers generally, and it was further complicated by a complex burden of disease – TB, HIV and AIDS as well as a non-communicable disease epidemic of trauma and diseases of lifestyle (Kautzky and Tollman 2008).

This changed model of health care coupled with higher education policies (DOE White Paper 3 1997, DOE Higher Education Act No. 101 of 1997, DOE National Plan of 2001) were catalysts nationally for significant educational and curriculum transformation at health sciences faculties. Faculties needed to produce graduates with the necessary knowledge and skills to practice at primary, secondary and tertiary levels of health care in a restructured South African (SA) public health system. Seggie (2010) reported that the main themes underpinning curriculum renewal processes at South African medical schools were that learning should be actively participatory and student-centred using problem- or case-based learning, that there be a shift from bio-scientific to bio-psychosocial model of illness and that students were required to have community-based learning opportunities and exposure to rural communities.

According to Seggie's review (2010, p11) all South African MBChB curricula post-1994 should adopt an 'integrated systems-based approach' to the study of sciences basic to medicine using clinical scenarios and patients as the focus of learning. Basic and clinical sciences needed to be 'integrated' in order to train students to 'act scientifically when they practise' medicine (Seggie p12, 2010). At the research site, the University of Cape Town (UCT), a restructured MBChB curriculum[2] was adopted in 2002 with the format being one of problem-based learning (PBL) supported by lectures (FHB2002). A move towards integration across relevant disciplines in medical programmes was a global trend (Jones et al 2001, Glew 2003). However, the forms that integration has taken in case-based curricula have raised concerns about the learning of relevant basic sciences, and about students' ability to integrate this knowledge and apply it in clinical contexts (Glew 2003, Malau-Aduli et al 2013). Reddy (2011) points out that the PBL approach, if not carefully implemented, may contribute to gaps in knowledge, and Tufts and Higgins-Oppitz (2009) found that physiology knowledge gaps in particular could disrupt the basis for clinical reasoning.

1.2 Rationale and significance

In Southern Africa, with the burden of disease and problems of co-morbidity[3], a diversity of complex treatment challenges present in all forms of clinical practice. This demands that for safe and competent patient care, practitioners should be able to analyse situations where there may be a variety of compounding factors requiring comprehensive problem solving capacity and an ability for critical thinking (Allers 2010, O'Connor 2011). With specific reference to rehabilitative health practitioners, the student in clinical years and beyond is required to assess impairment or injury to normal body function and apply appropriate therapeutics as is the case with physiotherapists, or adapt the clients' integration to occupation, as is the case with the occupational therapist. An understanding of body structure and function is essential fundamental knowledge, and specialisation is a process whereby physiology and anatomy is

[2] Alongside the MBChB curriculum reform, the Faculty developed 'multi-professional' courses where first year students from Medicine, Physiotherapy, Occupational Therapy, Audiology, and Speech Therapy are taught together. Examples of such courses include *Becoming a Professional* and *Becoming a Health Professional* and their purpose is for students to understand the scope of practice of the various professionals working within a team approach (FHB2002-13).

[3] Co-morbidity is when a patient presents with dual patterns of disease, for example being HIV+ while at the same time having TB.

integrated into professional knowledge and clinical application. Evidently the student needs to learn in such a way as to acquire the ability to integrate prior learned knowledge and apply it in different contexts and practices of the professional workplace. According to McKenna (2016, p178) students are differently prepared for key points in curricula that represent a substantial transition in how one works with knowledge and makes relevant connections, and it is the responsibility of each university to enable the learning needs of the students they serve, which would require 'rethinking many of our current curriculum structures'.

A Human Biology foundational curriculum is the focus of my study and I contextualise its brief history. Early in the millennium during a period of much socio-political change, and in the prevailing macroclimate of integration, disciplinary shifts and curricular restructuring, a merger occurred between the Departments of Physiology and Anatomy at UCT. In this process an interdisciplinary course called 'Human Biology' emerged to serve as the two-year foundational curriculum for the B.Sc. Physiotherapy and B.Sc. Occupational Therapy professional programmes. A more or less traditional model of curriculum was retained with foundational human biology in the first two years and clinical training in years three and four.

It is not only that an interdisciplinary course emerged but also that the physiotherapy students and occupational therapy students, after following separate and differentiated Anatomy and Physiology courses, were now a single large class following the same foundational curriculum. That there were previously separate foundational courses suggests that the rehabilitative professions require different fundamentals. The extent to which the integrated Human Biology curriculum serves the fundamentals of each profession thus became an important aspect to explore in this study. It is the work of my research to find out if the curriculum has been restructured in such a way as to enable integrative knowledge-building and professional specialisation.

Upfront I declare my personal involvement[4] with the Human Biology course for Health and Rehabilitation Sciences (HRS). As a lecturer I experienced the Human Biology curriculum over the last several years as organised by modules which did not seem to

[4] My personal and professional position is explained in detail in the methodology section of this thesis (Chapter 5) where I discuss issues of ethics and objectivity.

have obvious connections or linkage of concepts. As a participant in curricular reviews my perception was that there was little recognition of how structures of the different disciplines[5] shape curriculum, and as a participant in exam board meetings I was privy to data which depicted significant failures and underperformance, specifically in physiology. Clinical educators verbalised that students did not seem to be entering the clinical arena (clinical studies in years three and four) with the right kind of knowledge and skills.

These personal, and admittedly anecdotal, experiences fuelled my desire to undertake a rigorous exploration of the merger of the Physiology and Anatomy courses into Human Biology course taught to Physiotherapists and Occupational Therapists. I wished to further interrogate whether the foundational curriculum was organised in such a way as to provide students with access to practices and disciplinary knowledge that would enable cumulative knowledge-building (Maton 2009) and their entry into the arena of clinical reasoning and professional practice. In health professional fields integrative knowledge-building is key and scholarship on curriculum and knowledge structuring is much needed. My research hopes to make further contributions to these fields.

1.3 Research questions

Since the university's undertaking is to graduate physiotherapists and occupational therapists from more socially representative groups, this research into formative science education is important not only in critically evaluating the disciplinary fundamentals of professional knowledge, but also to explore the extent to which structuring of curriculum shapes student access to this knowledge. Exploring the underpinning structuring principles of the foundational curriculum aims to identify whether cumulative learning is enabled or whether epistemological or other constraints might operate to exclude certain students from acquiring a way of knowing that is needed to function in a changing society.

Within the brief of the 'Social Inclusion Project' this study investigates students' access to powerful knowledge and the disciplinary practices which support integrative

[5] The concept of knowledge structures is discussed in more detail in Chapter 3.

knowledge-building for the rehabilitative professions by asking this overarching research question:

> To what extent does the structuring of the foundational Human Biology curriculum shape students' access to professional knowledge?

Focus area 1. The foundational curriculum:

- *What organising principles underpin the disciplinary practices, contexts and dispositions of Physiology/Anatomy (before and after their merger)*
- *To what extent do the structuring principles of the Human Biology curriculum enable or constrain cumulative learning?*

Focus area 2: The rehabilitative health professions – realm of professional knowledge:

- *What organising principles underpin the professional practices, contexts and dispositions of Physiotherapy/Occupational Therapy?*

1.4 Brief overview of research process and thesis structure

The focus of my project explicitly foregrounds knowledge and curriculum. By way of the CHERTL, Rhodes University coordinated project, scholars were collectively introduced to Basil Bernstein's theories and sociology of knowledge, pedagogic codes and knowledge structures (Bernstein 1999, 2000). Legitimation Code Theory (LCT) developed by Karl Maton expands Bernstein's concepts as well as contributing novel dimensions which add considerable explanatory power to the analysis of practices, contexts and dispositions[6]. As a scientist who has transitioned to socio-educational research, I immediately found resonance with the power of LCT to make visible the organising principles which lie beneath knowledge practices. By building new knowledge using LCT I will also add to the corpus of LCT-based knowledge which is constantly growing.

[6] See work by Maton and others across a range of fields at www.legitimationcodetheory.com

In this chapter I have introduced the reader to the rationale and focus of my research, and I have outlined where I feel I can make significant contributions to educational fields. I follow with a broad outline of the thesis structure:

Chapter 2 characterises the biomedical disciplinary domains and the rehabilitative health professions. I describe the origins and development of the disciplines as underpinning medicine, and I outline milestones in knowledge-building of anatomy and physiology. In this way fields of specialised knowledge and knowledge communities, their respective boundaries and structuring and ways of reasoning can be better understood. By better understanding disciplinary autonomy and distinctiveness, the implications of their merging or integration may be better understood. I give an historical account of the disciplines at the university beginning with their establishment as foundational departments of a new medical school in 1912 up to the time of the merger and restructuring of the Departments of Physiology and Anatomy into Department of Human Biology. The section also outlines the development and specialisation of physiotherapy and occupational therapy in global and local contexts, and this allows for better understanding of their differentiated knowledges, procedures and skills and differential requisites for professional practice.

Chapter 3 elaborates the concepts which are core to this study. These include conceptualisations of transformation, equity and epistemological access; of disciplinarity as fields of specialised knowledge and knowledge communities and interdisciplinarity in globalised and localised socio-political contexts. The chapter conceptualises differentiated forms of knowledge, and sets out how knowledge is built, and put to work in different contexts. Curriculum and the development of different curriculum models are discussed, and attention is given to curriculum in medical and professional education.

Chapter 4 explains a social realist view that knowledge is socially constructed, is fallible and can be renewed; that there is a co-existence of knowledge and knowers in all practices; and that organising principles underpin practices, contexts and dispositions. This chapter explains key aspects of Bernstein's sociology and theorisation of knowledge and how it is structured, his conceptualisation of pedagogic codes (Classification and

Framing), and the pedagogic device which symbolises an arena of powers and values, contestations and struggles. Legitimation Code Theory (LCT) advances Bernstein's code theory and introduces several novel dimensions. I describe the dimensions, concepts and coding principles of LCT that I have used for my analyses.

In Chapter 5 I discuss my position as scientist, lecturer and inside researcher. Research ethics are described and the study methodology is detailed through the different stages from data collection to data interpretation and analysis. I also explain more precisely the ways in which I use LCT to analyse different data.

In the next two chapters I discuss my findings. Chapter 6 characterises the specialisation and semantic principles underpinning physiotherapy's professional practices and contexts, and occupational therapy's professional practices and contexts. In both case studies I trace how these organising principles may have transitioned alongside fundamental changes in curriculum, health sciences education and healthcare over the two decade study period (1994-2013).

Chapter 7 maps the position of Anatomy and of Physiology in the foundational curriculum for Physiotherapy, and for Occupational Therapy, according to their shifting from being disciplinary courses differentiated for the different professions, to their becoming an interdisciplinary programme. I discuss the organising principles underpinning the Human Biology curriculum and I point out key moments where structuring principles of disciplinary and curricular practices are altered and cumulative learning is impacted.

Chapter 8 concludes the thesis. I draw together all key findings and reflect on the extent to which the study has answered the research questions with respect to curriculum organisation, fundamental knowledge and professional knowledge, and enablement of cumulative learning. The significance of the findings and contributions that the study makes are elaborated, and I also reflect on certain limitations, and plans and recommendations for future research.

CHAPTER 2. CONTEXT — THE BIOMEDICAL SCIENCES AND REHABILITATIVE HEALTH PROFESSIONS

My study explores multiple interlinked contexts of a new interdisciplinary, foundational curriculum of two professional Bachelor's Degree programmes in the rehabilitative health sciences. First I elaborate the disciplines of physiology and anatomy which are complementary pillars of standard biomedical sciences curricula and which constitute the foundations of the health professions. Their fundamental orientation to medicine and the health professions is demonstrated by tracing developments and knowledge-building dynamics of each disciplinary domain. By understanding the distinctive features and organisation of each discipline, the reader may better appreciate the differences between the two domains and the nature of disciplinary boundaries. Section 2.1 concludes with a history of the disciplines at UCT (my study site) starting with the establishment of the Departments of Physiology and Anatomy at the medical school in 1912, and traces changes and advances in the respective departments throughout the century up to the time that a merger occurred early in the new millennium.

Secondly, in section 2.2, I provide an overview of the rehabilitative health professions - physiotherapy and occupational therapy. Knowing what the respective health professional does and how s/he is expected to perform in the workplace provides insights to the kinds of knowledge, procedures and skills that need to be acquired (and taught) during professional education. A background history of these professions in South Africa is briefly traced by describing the first formal educational programmes nationally and at UCT, and the establishment of a professional regulator.

2.1 The basic sciences of Medicine: Anatomy and Physiology

Anatomy and physiology comprise the basic sciences of medicine. In simple terms, physiology is the study of function and anatomy is the study of structure or form. Due to the connection between form and function, physiology and anatomy are intrinsically linked and are generally studied in tandem as part of the traditional curricula for Medicine and those fields allied to Medicine, often collectively referred to as the allied health professions. This section outlines the historical development of each discipline, alongside the knowledge progression or knowledge-building dynamics of each domain.

2.1.1 Anatomy

An historical perspective showcasing developmental milestones

The historical account of anatomy runs in parallel with the early development of medicine. While the focus here is predominantly on Western medicine development from the Greek period, it does not assume that advances were not made in other areas of the world such as China and India for example.

The narrative begins from the Greek and Roman periods as representing antiquity (starting ~ 400BC). Hippocrates and Herophilus were renowned Greek men of this time. Hippocrates is generally known as the father of medicine – from whence the Hippocratic Oath undertaken by newly graduated medical students around the globe. Herophilus is thought to be one of the first to perform dissections on human bodies while at Anatomy School in Alexandria, Egypt (Mayr 1982) and he is thought to have restored to the brain its status as the seat of intelligence, which Aristotle had denied (Beasley 1982). Claudius Galen (120–200AD) is understood to have been the attending physician at a gladiator school which provided him with ample opportunity to study the human body. He wrote treatises on human anatomy which were considered infallible authorities for nearly thirteen centuries (McMurrich 1930).

After the fall of the Roman Empire the study of anatomy stagnated in Christian Europe but flourished in the Islamic world. Anatomical treatises, lost to Europeans during several centuries of warfare and upheaval in the church, were fortunately translated into Arabic by Islamic scholars (Shoja and Tubbs 2007). While the Arabs did not add much that was new, according to McMurrich (1930) they kept the light through the Dark Ages and then restored light to the Western World where it had become almost extinct. Persian scholars developed an understanding of anatomy through animal dissections, evaluation of human corpses, and observations during surgical intervention on patients. Several Persian anatomists made contributions to medicine and to knowledge of the morphology of the human body. Rhazes (865 - 925 AD) penned two comprehensive books describing the anatomy of what he called simple organs (bones, nerves, muscles, veins, arteries) and compound organs (eyes, nose, heart, intestines); furthermore he was understood to be able to correlate lesions of the nervous system with clinical signs

and thereby pioneered a form of applied neuroanatomy (Shoja and Tubbs, 2007). Following on, Avicenna (980 - 1037 AD), a physician, teacher and researcher, contributed in significant ways to advancing knowledge of anatomy. He wrote 'The Canon of Medicine' which provided a link between anatomy and disease (Shoja and Tubbs 2007). Although it is not known whether Avicenna directly undertook human dissection, many of his descriptions of the structures of the body were novel, including that the aorta at its origin contained three valves which open when blood rushes out of the heart during contraction and close during the relaxation of the heart thus keeping blood from returning to the ventricle. This observation directly refuted Galen (Shoja and Tubbs 2007).

In Europe the Middle Ages suppressed personal initiative, and behaviour and actions were at the behest of feudal lords and church dogma. The Western world at the end of the Middle Ages was dominated by implicit trust in the teachings of the bible and by universal belief in the supernatural (Mayr 1982). Science languished in mediaeval times as there was no incitement to personal observation or experiment (McMurrich 1930). The endeavour to understand the causation of natural phenomena was virtually forgotten after the fall of Rome, and was to be revived again only in the late Middle Ages and during the Scientific Revolution (Mayr 1982).

Anatomy was taught in the mediaeval medical schools (Salerno[7] and Bologna in Italy; Montpellier in France) but in a peculiar literary way – the master or professor would recite[8] Galen and the assistant dissected the corresponding body part (Mayr 1982). The following account by McMurrich (1930) provides a glimpse of medical training and apprenticeship of the time: Frederick II (1194-1250) patron of the oldest medical school at Salerno promulgated an edict in 1241, setting forth license to practice medicine and surgery[9]. The requirements were science of logic for three years, then medicine for five years and practice of one year under a reputable physician. Afterwards there was a public exam at Salerno chiefly on the works of Hippocrates, Avicenna and Galen.

[7] At Salerno, established by the Benedictines, human bodies were apparently dissected for the first time in more than 1000 years (Mayr 1982).

[8] Vesalius (1514-1564) would change this form of teaching. He actively participated in dissection (Mayr 1982).

[9] There was a separation of surgery and medicine chiefly following the Arabic custom and tradition against the use of the knife (McMurrich 1930). The qualification MBChB maintains the separation to this day.

Mondino was a renowned Italian anatomist of the fourteenth century who staged public dissections. Using his book 'Anatomia' as an authoritative text, he taught anatomy by dissection. His book followed in order the various organs which would be exposed at autopsy, thus it was a manual of practical anatomy rather than a treatise on the subject (McMurrich 1930). The fourteenth and fifteenth centuries, however, added little to the superficial description of the human body. This was chiefly because there was no means of preserving bodies from putrefaction in the warm climate of Italy and thus work could not be prolonged over more than 3 days.

In the late fifteenth and beginning of the sixteenth century, dissection of the human body was a recognised feature of medical instruction. The long prohibition thereof, part sentiment and part religious opinion, had given way to the Renaissance (Mayr 1982). A standout figure of the Renaissance period was Leonardo Da Vinci, whose interest in comparative anatomy was an indirect result of his activities as a painter and sculptor. He was apprenticed to a Florentine artist in 1470 which was probably his first stimulus for anatomical studies (Cole 1944). His biological activities included representations of the wing and foot anatomy of the bird, and the mechanics of flight. He also depicted the facial muscles and nerves of the horse. Apparently he dissected about thirty human bodies and was denounced by the Pope for his practice of anatomy (Cole 1944). Da Vinci made more than five hundred drawings[10] of his observations and was the originator of cross-sectional anatomy (McMurrich 1930). Still acknowledged to this day, his anatomical drawings and depictions of levers, fulcra and forces were exceptional. It has been said of Da Vinci that he had the desire to know all things and prove all things for himself and that if he wished knowledge he sought it himself by observation - if observation failed to give desired results, the fault was with the observer not the method (McMurrich 1930).

The sixteenth century produced Andreas Vesalius (1514 – 1564) of Brussels who is regarded as a reformer who thought of anatomy in terms of design (Singer 1957). Vesalius gave lectures to large audiences, and emphasised the importance of

[10] Da Vinci's anatomical studies remained unknown to the scientific world for three centuries. Many of his works were lost or destroyed and were transferred over time from the Royal library of Madrid during the time of Don Juan, to the Ambrosian Library where after several works found their way via Napoleon to Paris (McMurrich 1930). Today a portion of the collection is to be found at the Royal Library in Windsor.

observation by, for example, demonstrating on live human models the position and outlines of joints (Singer 1957). He designed dissecting instruments (Mayr 1982) and corrected several erroneous concepts of Galen which were based mostly on animal dissections. Publishing extensively with abundant illustrations, he completed seven books in his series about the fabric of the human body 'De Humani Corporis Fabrica' (Singer 1957, Mayr 1982). These works revealed to scholars that anatomy can only be taught through dissection of the human body, and for this reason he is regarded by many as the 'Founder of modern Anatomy' (Rothschuh 1973).

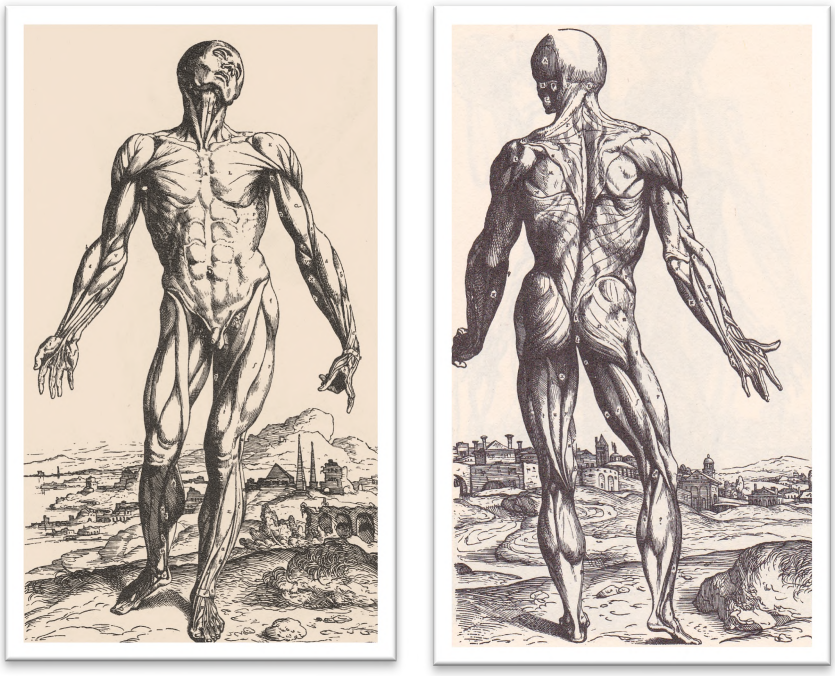

Figure 2.1. Vesalius' illustrations of male body musculature (from 'de Humani Corporis Fabrica' and reproduced in Singer 1957). Note typical depiction of man against rural backdrop.

With observation and drawing being central to the study of anatomy, an anatomist's popularity often depended on his drawing talents. Anatomy became associated with the curriculum of art academies. During this period William Harvey, an English anatomist, discovered how blood circulated through the human body and in doing so not only refuted Galen but also generated the seeds of physiological experimentation.

By close of the seventeenth century there were three great advances that benefitted all scientists: firstly there was the formation of powerful scientific societies that supplanted group meetings in private homes; secondly there was the founding of scientific journals;

and there was also the establishment of publishing houses as outlets for scientific books (Brazier 1984). It was within this milieu of academies and societies of science that the Royal Society (of London) came about. Membership was not limited to scientists but also physicians and surgeons and from its foundation the Royal Society displayed considerable interest in anatomical studies and in Medicine (Cole 1944, Brazier 1984). The Age of Enlightenment (eighteenth century) was a time when dogma, theological, philosophical or scientific was critically questioned; there were however not any fundamental changes in the development of anatomical sciences (Mayr 1982).

By the late nineteenth century anatomy was a standard part of the basic sciences curriculum of most medical programmes in Europe, USA, Australia and parts of Asia and dissection was made compulsory for medical students (Drake et al, 2009). The Anatomy Act of 1832 which was passed in England legalised the requisition of unclaimed bodies from workhouses and hospital mortuaries for dissection (Richardson 2004). Private anatomy schools closed and hospitals purpose-built dissection rooms. Anatomists largely finalised and systematised the descriptive human anatomy of previous centuries and Henry Gray (and Henry Carter) authored the highly influential text known now as 'Gray's Anatomy' which is still in use today.

In the preface to the thirty ninth edition of the seminal text (2004), the historian Ruth Richardson reflected on the anatomical sciences and prevailing attitudes during the past century. Richardson (2004) informs that Henry Gray and Henry Carter, both of St. George's Medical School in London embarked on a book of anatomy to guide physicians and scholars. The project started in 1855 and was finalised in 1858. Gray contributed to the text and Carter to the illustrations and both men were equally involved in dissecting the cadavers. The book was known as 'Anatomy - Descriptive and Surgical' and had both Gray and Carter's name inscribed on the spine. Gray died in 1861 at 34 years of age, from small pox.

From the 1883 edition of the book, embryology (outlining the various developmental forms of the human embryo) and histology (microscopic anatomy) were added. In 1909 (17th edition) the editor at the time decided to remove Carter's name. It is unclear why this decision was taken and it seems to be morally unsound as both men contributed

equally to the first edition. Had the book been devoid of Carter's illustrations it is unlikely that it would have been as popular and may possibly not have withstood the test of time. At the same time as the afore-mentioned omission of Carter, there was a name change and the book became known as 'Anatomy - Descriptive and Applied'. There were some key changes in 1938's 27th Edition when the name was officially changed to 'Gray's Anatomy'. Furthermore, X-ray plates were introduced as were electron micrographs and it was the first time that a woman (Ms AS Fitton-Jackson) was credited with contributing to Gray's. The editions after World War 2 gave the impression of 'intellectual stagnation' and the work became 'somewhat dull' according to the historian Richardson (2004, p6). That was until the key 35th edition in 1973 with over 780 pages newly written, one third illustrations newly commissioned, and new captions throughout. In another move the editors made explicit their intention to 'try and counter specialisation and compartmentalisation' by attempting to 'reintegrate the complexity of available knowledge' (Richardson 2004, p7). The editors also made mention of areas of ignorance and uncertainty. The 39th edition of Gray's Anatomy, published in 2004, differed fundamentally from previous editions in that the body was described in regions and not in systems. This type of organisation was believed to be of greatest benefit to practising clinicians as it would mirror their daily practice (Richardson 2004).

Gray's Anatomy is possibly one of the most famous medical books and its development over the past one and a half centuries tracks the advance of anatomical knowledge, alongside associated developments in imaging and computer-assisted 3D reconstructions. This authoritative text has been standard issue for medical students for well over 100 years. Since the beginning of the twentieth century all nerves, muscles, bones and organs have been named, classified and characterised and in this respect there has been relative stasis in our knowledge of gross anatomy of the human body.

Current knowledge-building and dynamics in the field

Rather than any breakthroughs in new knowledge, anatomy faces new perspectives in the way the subject is taught. Up until recently anatomy education comprising formal lectures and laboratory dissection of cadavers took up a large part of the early years (or

entire first year) in the standard medical curriculum and tended to be excessively factual, and overly detailed without the required clinical relevance (Turney 2007).

The basic biomedical curriculum became rather overloaded due to an explosion of knowledge in the molecular and physiological sciences (generating new chemical and biological disciplines) and some anatomists felt that anatomy became the target for those wanting to reduce curricular content and teaching time (Drake et al, 2009). Currently there are extrinsic pressures on the traditional medical curriculum such as an increase in number of students, costs and other difficulties related to maintaining dissection facilities, and also a reduction in the number of medically trained anatomy teachers (Turney 2007). Due to the various constraints, dissection of the human body[11] has been replaced in many instances by supplying students with anatomical models, and wet or plastinated cadaver specimens. In order to 'shake off the image of being old fashioned' Turney (2007, p107) proposed that anatomy should welcome models, computer-assisted learning, clinical relevance, radiographic images, prosection (previously dissected) and dissection provided the primary driver is the contribution to student learning and not cost-effectiveness or political correctness.

Traditional anatomy programmes had a regional organisation. For example in covering the upper limb region, lecturers would begin their teachings with the axilla and move down the limb to end with the fingers. The requirement to be sequential meant that certain students viewed the region as a sum of its parts rather than its whole (Drake et al 2009). Alternatively a systemic approach could be used where each system for example cardiovascular, respiratory, nerve, musculo-skeletal, urinary and so on, was taught and learnt separately. One of the drawbacks of this approach is that relationships and relatedness between systems is not always apparent to the student.

Some medical schools follow a problem based learning (PBL) curriculum[12] where clinical anatomy (focussed on an injured or diseased state) has become the relevant course. Some anatomy educators such as Louw et al (2009) consider that clinical anatomy has at

[11] South Africa's National Health Act 61 of 2003 (commencement May 2005) states that in terms of section 62, donation of the body of a deceased persons may be made for the purposes of the training of students in health sciences (...) in a nominated institution.

[12] Chapter 3 provides in-depth discussion on curriculum including case-based or problem-based curriculum.

times eclipsed disciplinary anatomy (which is about normal form, structure, blood and nerve supply to the part, tendons, bones, muscles and ligaments; relations to other structures, sex, age and so on). An ideal anatomy programme, they suggest, would integrate the disciplinary with the professional or clinical perspective and include surface and sectional anatomy so as to aid interpretation of the various imaging modalities such as MRI. Be it for medical or for the complementary health sciences, it needs to be clearly established what is core knowledge at the various stages of the anatomy curriculum.

2.1.2 Physiology

The term physiology has its roots in the Greek physis meaning 'nature' and logia meaning 'knowledge or study'. The word physiology emerged when French physician and mathematician, Jean Fernel (1497-1558) used the term to mean 'actions of living things' and afterwards Swiss physician, Theo Zwinger, published 'Physiologia Medica' where physiology evolved to become more a way of conceptualising vital actions as a subject of medical enquiry (Rothschuh 1973). Physiology as the science concerned with vital and organic functions, and quite distinct from anatomy, emerged during the 16th century Scientific Revolution with Herman Boerhaave (1668 – 1738) a Dutch physician and chemist, who wrote a textbook of 'Physiologia' (Hart-Davis et al 2014). In 1751 Albrecht van Haller published two works on 'Physiologiae' which elevated physiology to the rank of an independent science. However it was not until the nineteenth century that physiology detached itself generally from anatomy to finally become the physics and chemistry of bodily functions (Rothschuh 1973). Physiology is the scientific study of function in living organisms and more specifically is the science underpinning our understanding of how biomolecules, cells, organs and biological systems interact to perform biochemical, electrochemical or physical functions.

An historical perspective showcasing developmental milestones

In ancient Greece, during the time of Hippocrates (~ 420 BC) knowledge about the workings of the human body was surmised from observations. The Greeks believed humans were made up of four body humors or fluids which were governed by four

elements being earth, fire, water and air[13] (Beasley 1982). Hippocrates maintained that health required a balance of these elements and that imbalance resulted in disease (Beasley 1982). The Hippocratic School of Thought perpetuated by Galen influenced the basis of medicine for nearly 1000 years.

Galen (126 - 199 AD) built on Hippocratic concepts that health required a balance between four main body fluids. Galen viewed the body as consisting of three connected systems: firstly, brain and nerves (sensation and thought); secondly, heart and arteries (vital spirit); thirdly, liver and veins (nutrition and growth). In the heart, blood in the left ventricle came from blood in the right ventricle through pores in the septum. Galen (and the Greeks) believed that the function of the left side of the body vasculature was to deliver fresh air and cool the body; and that of the right side of the body vasculature was to deliver products of healthy diet to tissues of the body (Schultz 2002). Galen's model of circulation, therefore, was about ebb and flow delivering 'spirit' to the periphery, where one had to eat to sustain blood levels. Galen was revered on levels akin to Hippocrates, Plato, and Aristotle and this contributed to his model surviving for many centuries despite being groundless (Schultz 2002).

During the Middle Ages, classical medical knowledge which had been lost in the Latin West was preserved, translated and incorporated into Islamic medicine (Mayr 1982, Shoja and Tubbs 2007). Experimental science started to emancipate itself from philosophy in the late Middle Ages and in the Renaissance (Mayr 1982). Leonardo da Vinci made copious drawings with accompanying text of his views regarding function of organs. He postulated the origin of voice in the larynx, he believed muscles were stimulated to contract by nerves, he was well acquainted with functional connections between brain, spinal cord and nerves and he made an attempt to 'express vital actions as the result of natural physical forces' (Rothschuh 1973, p43) but because his works were unavailable he barely influenced physiology of the time.

Physiology has its foundations in the sixteenth and seventeenth centuries, an era known as the Scientific Revolution, or the Age of Experimentation and the Scientific Method.

[13] Pythagoras had a theory that numbers possessed certain qualities and virtues; out of this grew the concept that life was made up of four elements - earth, air, fire and water - each representing a blend of four qualities - dry, cold, hot and moist; and leading to the four humours or body fluids (Beasley 1982).

The entire sixteenth century was a period of awakening in the West typified by Copernicus' published work that the earth was not stationary but travelled around the sun. Vesalius's detailed anatomical drawings provided an understanding of the human frame which in turn was a precondition for progress in physiology, however 'knowledge of morphology seldom contributes to solutions of existing physiological questions' Rothschuh (1973, p67).

William Harvey (1578 – 1657) a lecturer in Anatomy at the College of Physicians is considered by some to be the Father of modern Physiology and Medicine (Schultz 2002). He undertook vivisectional experiments and careful observations to shed light on the natural world and it was through scientific method that he was able to abolish Galenic dogma which had persisted for centuries. Harvey used tourniquets on the forearm to determine the flow of blood in the veins. His revolutionary paradigm (published in 1628) was that blood is conserved and circulates: blood is pumped by the heart (a contraction brings about a pulse), performs a circuit in only one direction and returns to the start point. Harvey's work not only established a seminal property of the cardio-vascular system but also demonstrated the power of the scientific method. It was, however, many years before his work became recognised (Schultz 2002). During this era[14], experimentation or the 'use of the hand as instrument of the mind' (Osler's 1906 oration paraphrased by Schultz, 2002 p178) in addition to observation became recognised as essential tools of scientific method. Harvey used novel approaches in attempting to answer questions about other body functions. This was the impetus to development of models (i.e. biophysics and mathematics) for the explanation of physiological phenomena (Rothschuh 1973).

In the 1620's the English philosopher and scientist Francis Bacon[15] (1561 – 1626) was the first to set out inductive reasoning and insisted on evidence from the real world (Hart-Davis et al 2014). In so doing, he contested the models of the ancient Greeks who believed that truth came from argument amongst clever men. Two key works by Bacon reflect his ideas for scientific enquiry: 'Novum Organum' (1620) outlines scientific method as observation, deduction from what is observed and experimentation to test

[14] Galileo and Copernicus made breakthrough discoveries in this era.
[15] Harvey was for a period Francis Bacon's physician.

theory; 'New Atlantis' is about experiments and inventions (Hart-Davis et al 2014). Later, the French philosopher René Descartes insisted on rigorous scepticism in discourse in method. Descartes also had interests in physics and mathematics. He published 'De Homine' and was the first to attempt an explanation of bodily functions according to mechanical laws (Rothschuh 1973). From this point on, solutions to physiological problems were approached by observation, experimentation, the application of chemistry and physics, and inductive reasoning thus heralding the scientific or experimental method, a key aspect of which was that a hypothesis was not regarded as a fact. Robert Hooke was elected as the first 'Curator of Experiments' (Royal Society) to promote and cultivate the experimental approach to science as contrasted with purely literary efforts of previous scholars. In this respect the biological activities and methods of the French Academie des Sciences (established 1666) at first surpassed those of the Royal Society (Cole 1944).

Robert Hooke (1635 - 1703) was not the first to observe life using the microscope[16] - the first microscopes were made by Dutch spectacle makers. However he was the first to publish intricate drawings of his microscopic observations, such as the compound eye of the fly, and detailed anatomy of bees and fleas (Hart-Davis et al 2014). He is best known for his descriptions and illustrations of cork which showed that living organisms were made up of units called cells. The new worlds beyond those observed with the naked eye were now being interrogated. This was a key milestone in the development of physiology. Without the help of the microscope the physiological explanations of various organs would never have advanced. Gross anatomy had allowed only speculation of physiological function, and now microscopic views allowed elaboration.

Antonie van Leeuwenhoek (1632 – 1732) of Delft in the Netherlands[17] was a draper by profession. He made his own microscopes –thought to have numbered more than four hundred– not with compound lenses but rather a single high quality lens affording magnification of up to 200X (Cole 1944, Hart-Davis et al 2014). Van Leeuwenhoek is acknowledged as the first to see single cell microscopic organisms. He looked for life

[16] Galileo inverted the telescope to view insects in the early 1600s (Rothschuh 1973).

[17] The 17th century was the golden age of the Dutch nation as sea traders, in art, literature and science despite the Dutch Reformed Church regulating morals, austerity and discipline to mould the national character (Cole 1944).

forms in liquids and observed human sperm, blood cells, bacteria and protozoa. He described the optic nerve (of a cow), he observed axons within the compound nerve (though not recognised as such at the time) and also the striated nature of muscle fibres (Brazier 1984) (refer Figure 2.4). He is also known to have written more scientific reports of his findings to the British Royal Society[18] than anyone in history (Hart-Davis et al 2014). He was the pioneer of micro-dissection and succeeded in obtaining results transcending what could be expected from a new and difficult method. Cole (1944) considers that van Leeuwenhoek's manipulative skill must have been astonishing, given that his apparatus was the simplest and that tissue impregnation / hardening and staining were unknown in his time.

Figure 2.2. Leeuwenhoek's dissection of Cochineal showing detail of various larval stages. (from Mayr 1982)

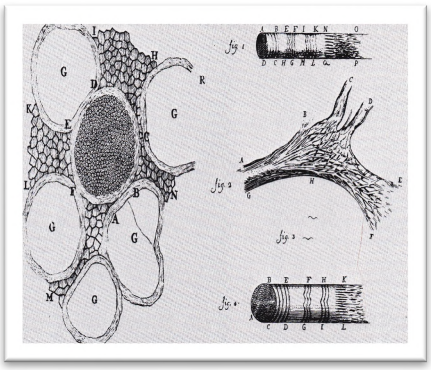

Figure 2.3. Left: cross section of what Leeuwenhoek described as 'slender vessels of indescribable fineness, running lengthwise to form the nerve' (Epistolae physiologiae no 32).
Right: Leeuwenhoek's drawings of muscles.(from Brazier 1984)

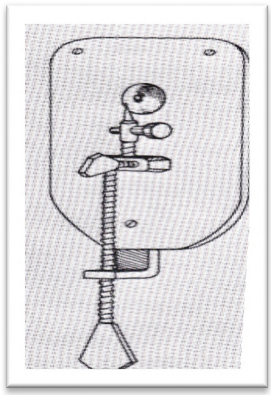

Figure 2.4. Sketch of Leeuwenhoek's microscope showing silver point on which the specimen was mounted and the adjustable screw to bring it into position.

The Age of Enlightenment (eighteenth century) signaled a period where people became highly receptive to sciences, and a scientist had high standing in society (Rothschuh 1973). It was an intellectually liberating time where a line was drawn between science and theology. Deism was excluded but in its place there was nature – the two were not

[18] Royal Society sent three priests to certify that he really saw such things (Hart-Davis et al 2014).

to be confused (Mayr 1982, Brazier 1984). Enlightenment had its core in France following Descartes – its followers became known as philosophers (Brazier 1984). Through the 18th Century a new profession was created distinct from that of the philosopher - 'a cultivator of science in general – call him a scientist' (Hart-Davis et al 2014 p73). The rise of science also saw a gradual decline in popularity of Latin, and instead the use of national languages in scholarly material (Mayr 1982). Another significant milestone and break from established norms was the emergence of textbooks on physiology as distinct from clinical treatises or anatomical texts (Brazier 1984). Herman Boerhaave (1668 – 1738) wanted to provide medicine with a firm foundation based on knowledge obtained in the natural sciences. Chemistry[19] and physics contributed methods and ideas to solve physiological problems and he synthesised various disparate theories and discoveries into practical medicine (Rothschuh 1973).

Physiological knowledge expanded rapidly from the mid-19th century. Modern physiology arose in tandem with the application of instrumentation. Scientists expressly wanted to discover the laws of nature with the help of reason and newer scientific methods. Physiologists moved forward with describing function in terms of physical and chemical principles, with a conscious separation from structure and morphology / anatomy thereby establishing distinct disciplinary boundaries. Physiology thus emerged as an independent field of knowledge where before it had been connected with general pathology, anatomy and clinical medicine. Physiology labs in which experiments could be performed were housed at first in small rooms connected to and often in a dependent role to the anatomical sciences (Rothschuh 1973). With the exception of Claude Bernard and his students in Paris, Germany was the leading country for physiological advancements, and this was due to two men, Johannes Muller and especially Carl Ludwig who influenced the next generations of physiologists (Fye 1986). Muller, who influenced a large number of students, taught both anatomy and physiology together until he died in 1858. Only thereafter were his successors able to separate the disciplines. At other universities separation of anatomy and physiology chairs happened a bit later, but by the last quarter of the nineteenth century detachment and

[19] Von Helmont (1577-1644) saw life processes as chemical processes. He started a new tradition in physiology understood as the 'chemicalisation of physiology' (Mayr 1982).

independence of physiology from anatomy was achieved worldwide and it was an entirely autonomous field based on physico-chemical principles and experimental method[20] (Rothschuh 1973).

Claude Bernard (1813–1878) held the Chair of Physiology at the Sorbonne. He attracted students to Paris, and over a thirty five year period he and his students published hundreds of science writings. At the heart of Bernard's programme was the importance he attached to pedagogy in an experimental laboratory setting (Coleman 1985). He campaigned for the distinctiveness of physiological enquiry, its intellectual and pedagogical independence and in his later years worked tirelessly to justify the disciplinary autonomy of experimental physiology (Coleman 1985, Sefton 2005). According to Bernard, an organism was an 'integrated whole' and life had to be viewed 'both as organisation and coordination' (Rothschuh 1973, p269). These ideas led to his conceptualisation of *milieu interieur* where he described the constancy of the internal environment necessary for independent life. American physiologist Walter Cannon later extended the concept as 'homeostasis'[21] (Rodolfo 2000).

A breakthrough moment in modern physiology can attributed to the work of Carl Ludwig (1816 – 1895) who introduced in 1847 the revolving drum recorder – kymograph – to record blood pressure, as well publishing two volumes of physiological text. Ludwig established the Institute of Physiology in Leipzig and it was here that the experimental, causal and analytical method came to the fore. Ludwig's quantitative (graphical and numerical viewpoint) and physico-chemical approach to physiology spread widely especially to the USA, Great Britain and Russia (Fye 1986). Karl Vierordt, a fellow German physiologist, extended Ludwig's kymograph to allow physicians to have visual records of clinical signs that previously they obtained by touch and palpation. The kymograph was further refined to record not only multiple phenomena but also to record measurements over an extended period. Recording instrumentation allowed precise measurement and eventual mathematical analysis of complex interrelated events so that physiological experimentation methodology was more aligned with the physical sciences and

[20] Physiology's hard earned separation from anatomy contrasts with the merger that is the context of my study.

[21] Homeostasis is essentially the maintenance of a functional environment and as such involves the complex interaction of hormonal, nervous and various other signals.

chemists. Physiologists could now study dynamic processes[22] rather than the mere measurement of static events.

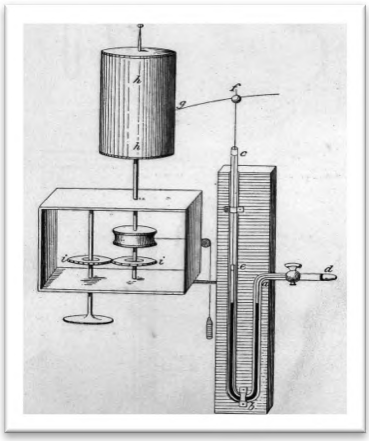

Figure 2.5 Kymograph for recording of blood pressure as depicted in Ludwig's 'Lehrbuch'. (Wellcome images)

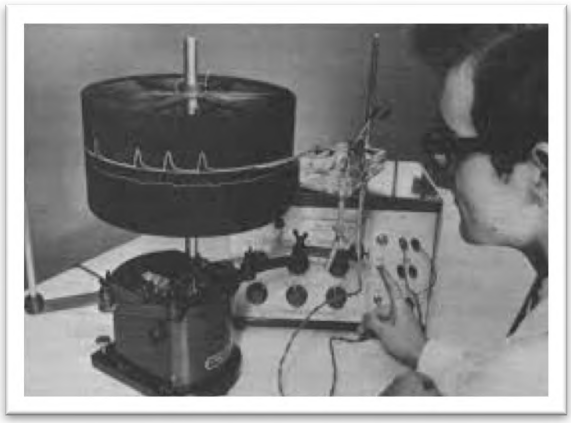

Figure 2.6 Kymograph being used in an experiment. The carbonated graph paper on the revolving drum shows two traces drawn by the electronic pen recorder. (Google)

By the 1850s and 1860s, indications were that new methodologies of physiologists could be applicable at lab bench as well as at the bedside, that is to say applicable in clinical settings and for diagnostics. A turning point in its history, physiology could equally claim a role as the foundational subject of scientific medicine as well as being the epitome of the experimental method in life sciences; thus gaining social authority both in science and in medicine (Borell 1987). Between 1860 and 1890 many American students did apprenticeships in Ludwig's lab in Leipzig, Germany where they learned experimental design, experimental procedure, and experimental analysis. These students then returned to the US with skills and knowledge and also equipment (Fye 1986). By the 1890s the laboratory, which initially was the professor's domain with a few advanced students, became a pedagogical space especially in the US (Borell 1987). Introductory students started out by learning from routine demonstrations, and then advanced to their own hands-on experience. Method, procedure and technique became increasingly important and students learned to manipulate as well as observe and describe. Scientific knowledge was gained directly by experience in the lab where students were stimulated

[22] Ettiene Marey developed the cardiograph, pneumograph, myograph, thermograph and polygraph. He would also later develop chrono-photography which became useful in the biological sciences. He was famous for skilful investigation of cardiac and circulatory physiology.

to enquiry rather than depend on the authority of didactic lectures (Borell 1987). The new style of pedagogy was reflected in textbooks of the period (1890-1910) which emphasised hands-on experience for introductory students so that they might be explicitly trained in analytical method as well as in subject; American educators spoke of the need to train 'for power' by teaching methods of scientific reasoning and analysis rather than facts (Borell 1987, p60).

Transformation from research lab to teaching lab required major investment of personnel and capital by the college or university. Lab development provided jobs for many: experimentalists were hired to provide hands-on training to introductory students. Many Chairs, labs and Departments of Experimental Physiology were created; physiologists built research groups and schools. In 1900 the Harvard Apparatus Company in Boston made teaching apparatus (kymographs) for physiology students at Harvard medical school and within 5 years (by 1905) it supplied kymographs worldwide so that this recording apparatus became a skill to be learned by students in introductory courses in all medical schools. (Botany and Biology were also transformed by the kymograph which became essential experimental apparatus for life scientists).

By the end of 19th century physiology was the foundation of scientific medicine. The development of recording instruments[23] extended the intellectual power of physiology to transform medicine into a predictive law-bound science of health and disease (Borell 1987). Additionally, instrumentation removed the researcher from intervening in the measurement of the event and researchers could claim objectivity of their science (Hoff and Gedes 1959). Physiologists were able to measure as well as describe physiological processes and physiology transformed rapidly from a primarily descriptive, vivisectional and anatomically-orientated activity to a quantitative experimental science (Fye 1986).

[23] There were progenitors to Ludwig's kymograph - a growing number of recording instruments in meteorology, physics, and industry were developed as the industrial revolution was achieved, and scientists began to study the nature and means of control of the new forces. These events centre on the scientific world of Paris in the 1840's, and the stimulus seems to have come from invention of the galvanometer by Claude Pouillet, a professor of physics. At the height of this general development the kymograph appeared as a special application of recording techniques to physiology (Hoff and Gedes 1959).

Recent and current knowledge-building dynamics of the field (twentieth century)

August Krogh[24] held the Zoophysiology Chair, specially created for him, at the University of Copenhagen. In his opening address to the thirteenth International Physiological Congress Krogh acknowledged how physiology had been brought into close contact with mathematical and statistical analysis, and how chemistry and physics were utilised and adapted for physiological problems. He recognised the very rapid expansion of physiology and how physiology was growing unwieldy and needed to separate into independent[25] sciences:

> It is impossible for any single human being to be familiar with modern physiology in all its branches in the sense in which the great teachers of twenty or more years ago were familiar with the physiology of their time (…) we have to face the splitting of physiology into more or less separate and independent sciences and we are confronted with the problem of finding the right lines of cleavage (Krogh 1929, p2).

Krogh (1929, p3) cautioned against specialisation (example endocrinology, muscle physiology) because he believed the activities of organisms were 'too intimately correlated to allow much specialisation'. Acknowledging that physiology as a science had its origins in the necessities of practical medicine and that most physiologists had appointments in medical schools, he advocated chairs and labs for physiology of disease / experimental medicine and at the same time physiology chairs that were independent of medicine[26]. On the research and publication front, Krogh proposed the greatest possible care to verify facts and substantiate conclusions before publishing results. He concluded his address by speaking about the need for cooperation between laboratories and individuals: 'many problems can only be attacked when experimental physiologists cooperate with histologists, with chemists or physicists or with clinicians … some problems will require combined efforts' (Krogh 1929, p8).

[24] Krogh worked on gas exchange in the lungs, and osmotic regulation in capillaries and membranes, and was known for clear experimental formulations and imaginative methods (Rothschuh 1973).
[25] Biochemistry and Biophysics had obtained independent chairs and labs at many universities.
[26] Krogh occupied the Chair of Zoophysiology in Copenhagen - I understand him to refer to similar such Chairs and labs.

Growth and development in the field of physiology during the 20th century can be gleaned from the sequence of discoveries as recognised by the Nobel Prize for Physiology or Medicine. These awards reflect significant advances and discoveries, and reflect also the emergence of sub-specialities such as biochemistry and molecular biology from the parent discipline, physiology. In turn molecular biology has spawned super-speciality fields, where there have been proliferations of discoveries. Laureates have been rewarded for their contributions in the field of signal transduction, neurobiology and intermediary metabolism. In the 20th century, biologists also became interested in how organisms other than human beings function, spawning sub-fields such as evolutionary physiology[27], ecophysiology and comparative physiology, microbiology and virology.

Alfred Nobel, himself a physiologist who conducted experiments in blood transfusions, wanted to establish a prize for progress through scientific discoveries in laboratories. Nobel's will stipulated a prize for Physiology or Medicine, which allows it to be awarded in a broad biomedical field inclusive of various subspecialties as well as in clinical medicine, and the will further stipulates the award be for 'discovery[28] and greatest benefit to mankind' (Lindsten and Ringertz 2011). The Nobel Prize in Physiology or Medicine has, since 1901, been awarded by the Royal Swedish Academy of Sciences/ Nobel Assembly of the Karolinska Institute who, according to a rigorous process, select prize-winners from those nominated by the international scientific community. The award has been shared more often in the second half of the 20th century (59 awardees in the period 1901 – 1950 versus 113 awardees in the period 1951 – 2000) which reflects a burst of growth in the scientific community since World War II, and it also reflects how biomedical research increasingly is performed in teams rather than by solo scientists (Lindsten and Ringertz 2011).

The Nobel Prize for Physiology or Medicine has been criticised for omissions, mistakes and for not recognising the contributions of women[29] (Lindsten and Ringertz 2011,

[27] Darwin published *Origin of Species* in 1895 generating much interest in this field.
[28] Discovery means a sudden breakthrough and significant increase in new knowledge.
[29] Statistics (as at 2014) show that the Physiology or Medicine Prize has been awarded to 199 men and only 10 women. Zarate et al (2015) point out that the prize has been awarded in the areas of physics, chemistry, physiology and medicine to 852 persons up to 2014 of whom only 45 have been women.

Zarate et al 2015). The phenomenon of sexism in science is of personal interest and this study's concern with social inclusion, as described in Chapter One, means it is of some pertinence here. Doing due diligence to the topic is however beyond the scope of this study, and I raise a few points of discussion only briefly. Women have long been present in science although most have not been in highly visible, rewarded roles (Noordenbos 2002). That scientific careers are not gender equitable, is demonstrated for example by an extensive American study which showed that although men and women are as likely to obtain their science doctorates at top ranking institutions (in the US), women's degrees do not translate into expected professorial rank over time (Fox 2001). Another study (Rayman and Brett 1995) found that female science, technology, engineering and mathematics graduates were not advancing into doctoral studies nor persisting in science careers on par with male counterparts. In the UK, women are the minority at all academic levels in Science, Engineering, Technology and Mathematics departments, with recent figures indicating that only 9.3% of professors are women (Butcher 2011). As to the reasons for the remarkable underrepresentation of women in the higher echelons of academic science, many studies point to institutional factors and the social structures of science (Noordenbos 2002).

By the 21st century science has become largely a team activity, involving expensive equipment and interdisciplinary collaboration. The most illustrious example has been the Human Genome Project (completed by 2003) – the largest international biological research project ever, which successfully mapped all 20 000 genes of the human genome. Genomic medicine holds the ultimate promise of revolutionising the diagnosis and treatment of many illnesses (Collins and McKusick 2001). There is fierce competition in the scientific enterprise. Current day science revolves around collaborations of human resources and cooperative use of costly equipment; a social network of communication, interaction and exchange. Within this kind of social structure barriers (formal and informal) can exist by isolation from professional and collegial networks, and through fewer opportunities for research and training (Rayman and Brett 1995, Fox 2001). Within the organisational context of science, men have different opportunities than women to participate in research groups, collaborate in scientific enterprise, and publish findings. Fox (2001) argued that if women are constrained within the social networks of

science (be these in departments or across extended scientific communities) then this restricts their possibility of participating in research, publishing and being cited, typically marks of status and performance in science. Women and other marginalised groups have more chance of success in science when institutions and departments provide welcoming and supportive climates of social inclusivity.

2.1.3 History of Physiology and Anatomy at UCT

Professor Jan Louw, a specialist physician at Groote Schuur Hospital (GSH) and renowned for establishing paediatric surgery in South Africa, spent ten years researching the history of medical education at UCT. I use his nearly four hundred page publication 'In the shadow of Table Mountain' (published 1969) as an authoritative, comprehensive historical perspective of UCT Medical school up until around the 1960's and which at the same time provides a history of physiology and anatomy at the university.

At the turn of the century, all South African doctors underwent their medical training in Scotland and England. In 1889, however, the president of the Colonial Medical Council, Dr. Dodds made a plea for the foundation of Chairs of Anatomy and Physiology. This would mean that aspirant medics could take a Science degree with Physiology and Anatomy, and 'be grounded in the fundamental sciences of the profession' (Louw 1969, p45) such that they need only be abroad for the last three of the five years training (5 year curriculum at the time). In 1911 Chairs were advertised and filled - Professor Thompson for Anatomy and Professor Jolly, a medical man as well as a Doctor of Science, for Physiology. June 1912 saw the opening ceremony for the Physiology and Anatomy laboratories at Hiddingh campus in The Gardens. The period from 1912 to 1919 saw growth in the number of admissions to first and second year courses with basic training in anatomy and physiology given to about 1000 students during this period. The accommodations of anatomy and physiology labs soon became too small. Professors Jolly (Physiology) and Drennan (new Anatomy professor) are reported to have worked in close co-operation and been an ideal team for initiating young students into the 'mysteries of medicine' (Louw 1969, p101).

Figure 2.7. Building housing the Departments of Physiology and Anatomy, established in 1912. (www.cca.uct.ac.za/centenary-history-experience)

Figure 2.8. Some of the first medical students in the Anatomy dissecting laboratory. (www.cca.uct.ac.za/centenary-history-experience)

Table 2.1 Excerpt of the Anatomy and Physiology syllabus, 1912 - 1919.

Anatomy 1st year course [50 lectures -150 hours practical work] Anatomy 2nd year course [100 'meetings' - 200 hours practical work]	Position, form and general arrangement of different systems of human body, structure of various organs and tissues, surface and sectional anatomy. Physical anthropology. Dissection of human body at least once.
Physiology 2nd year course[30] [100 'meetings' - 180 hours practical work]	Physiology of all body systems. Practical work in histology, experimental physiology, physiological chemistry.

Barnard Fuller, in 1916, put a proposal to senate for a 3rd year medical course and for three new Chairs of Pathology, Pharmacology, and Bacteriology - three years later this was to be realised. According to Louw (1969), the South African College (SAC) became the University of Cape Town by an act of parliament in April 1918 with six faculties including Medicine. World War 1 hastened medical progress especially in surgery and investigation of surgical disease; wound treatment by physiological, biochemical and microbiological methods; and therapy by blood transfusions. In 1918 Professor Jolly was appointed the first Dean of the new Faculty of Medicine and students could complete a full MBChB (6 year curriculum) in Cape Town and no longer needed to go overseas. According to Louw (1969, p141), Professor Mackie's opening address announcing the complete curriculum in Medicine contained several salient points. He stated that the

[30] From inception Physiology was established as a second year course.

medical school had to train medical scientists as well as medical practitioners; that applications in medicine could only be appreciated after a thorough grounding in the pure sciences; and that the student was not to expect of the university a purely didactic form of teaching which would spoon-feed what was required for a particular examination … 'the student while being taught what is already known should also be learning how to know more'.

The MBChB comprised pre-medical courses of Zoology, Botany, Physics and Chemistry which were taught by Science Faculty, while the medical courses namely Physiology, Anatomy, Pathology, Bacteriology, Pharmacology, Biochemistry, were taught by the Medical Faculty. A Chair of Biochemistry (physiological and pathological chemistry) had not yet been initiated and the teaching of this subject reverted to the Physiology Department[31] even though Professor Jolly (Dean and HOD) had expressed the need for the services of a specialist as advances in knowledge of the subject had become so vast. During the period 1920 – 1927 there were two streams of study, one of which was a preclinical course and the other a degree qualification (medical BA).

MBChB preclinical courses

1	Anatomy 1, Botany, Zoology, Chemistry, Physics
2	Anatomy 2, Physiology 1 (including chemical Physiology / Biochemistry)
3	Bacteriology, Pharmacology, Pathology

Medical BA

1	Botany, Zoology, Chemistry, Physics, and Language
2	Anatomy 1, Physiology 1 (including chemical Physiology / Biochemistry), and Arts
3	Anatomy 2, Physiology 2 and either Bacteriology, Pharmacology or Pathology

In 1927 the Science Faculty accepted courses in Physiology and Anatomy for BSc and MSc degrees. Also students could proceed with MBChB thus obtaining a BSc MBChB in seven (7) years. The year 1928 signified the move of the Departments of Anatomy and Physiology to the new site in Observatory and the relocation of both departments to the Wernher Beit Building.

[31] Biochemistry teaching was the realm of the Physiology Department well into the 1990s.

In 1929 the South African Medical and Dental Council (SAMDC) was established to oversee ethics of medical practice and also standards of medical education. The regulatory body deemed that a student could only commence with professional studies after completion of qualifying courses in Physiology and Anatomy. In 1931 Professor Jolly, active researcher and student mentor,[32] Head of Physiology and Dean of Medicine since 1911, resigned the Deanship but sustained his contributions in research and teaching capacities. The Great Depression characterised 1932-1933 - insofar graduate courses, the medical BA was dropped in 1934 but the BSc continued.

Restricted admissions, fluctuating student numbers, and the extension of teaching facilities during the war years and post-war[33] recovery read as follows: UCT Council decided in 1942 to restrict admissions in terms of numbers, although there were of course already restrictions in place as entry to the school was reserved for whites. Admissions were to be considered on the basis of academic qualifications. Limited accommodations were cited as a reason. One hundred and fifty students were accepted, sixty nine were refused. After the war, there was a swell in the number of students many of whom were returning servicemen.[34] Second year student numbers were restored to one hundred and fifty by 1949 and beyond. Teaching and curriculum in post-war times reflects staff shortages in Anatomy and student overcrowding which resulted in eight to ten students per cadaver (Louw 1969). Senior students were invited to act as special demonstrators / junior lecturers. It was circa 1950 that a junior lecturer was given the task of lecturing those who were preparing to become physiotherapists and could not study in England because of overcrowding there. So began the training of physiotherapy students in the Anatomy Department (Louw 1969). The department was also responsible for Anatomy courses for the Diploma of Nursing, and for teaching anatomy at the Michaelis School of Fine Art. The Physiology Department was also overcrowded not least because students from the Science Faculty were attending classes together with medical students. Due to staff shortages a number of recent

[32] Seven PhDs were awarded in Physiology and one PhD in Anatomy between 1930 and 1937. Physiology graduated a further five PhDs and six MSc after WW2 and up to 1950. As far as I can ascertain Anatomy did not graduate any postgraduates during this time.

[33] Several advances were made in medical sciences on account of World War 2, for example development of antibiotics, better blood transfusion methods, control of virus infection and resuscitation.

[34] Of interest given the language debates of today, the first year courses of Zoology, Botany, Physics and Chemistry were, for a period after the war, offered in dual medium - English and Afrikaans (Louw 1969).

graduates were appointed as part-time lecturers. Louw (1969 p348) described that post-war there was a generalised and determined 'move away from formal lecturing', a 'tendency towards integration of all subjects' and greater emphasis was placed on knowledge of the basic sciences although he does not provide any clarity on what forms these assumed in curricula.

Louw (1969) reports that enthusiasm for science courses waned during the war, perhaps because they were regarded as non-essential for the war effort. As of late 1940s the science course for anatomy was discontinued which meant that anatomy was officially dropped as a major for BSc. Meanwhile 1949 offered the last BSc (Medicine) for the next sixteen years until it was reinstated in Faculty of Medicine in 1965. As of 1967 Biochemistry was inaugurated in the Science Faculty and the Medical Faculty started negotiating for Medical Biochemistry. This development was evidently slow in manifesting as the teaching of Biochemistry[35] to medical students remained the responsibility of the Physiology Department until the late 1990s.

The Department of Anatomy moved to new premises in early 1970s (according to UCT archives) and took residence in what became known as the Anatomy Building. This building was designed to accommodate anatomical dissections in several large halls, and to accommodate cadaver receipt, storage and preparation for student teaching. The department was foremost concerned with teaching and not much research was done. The Department of Physiology was to remain in the Wernher Beit building it had occupied since 1928 until a physical relocation to the Anatomy Building in 2003. The core functions of the Physiology Department were twofold - relevant medically-oriented scientific research, and teaching of medical students, undergraduate and postgraduate science students, and teaching of physiology to physiotherapy students, and a separate class for occupational therapy and nursing students (later nursing was dropped as explained in analyses Chapter 7).

Interviewed by the medical student publication 'Inyanga' (1983), Theunis Coetzee, Professor of Anatomy and Head of Department, a medical man and active clinician, regarded his department to be 'overteaching anatomy' to students, the bulk of whom

[35] The course was known officially as Physiology and Medical Biochemistry (PMB).

would become general practitioners rather than surgeons or professional anatomists (Inyanga 1983, p18). Professor Coetzee suggested that six months of anatomical training, relevant to the clinical situation, should be sufficient for general practitioners. Furthermore, he proposed that anatomy is better retained by the more mature medical student who knows better what is clinically relevant, and for that reason he advocated that fourth or fifth year students have the opportunity to do tutorial style revision in small tutorial groups. Professor Coetzee's comments on the state of healthcare at the time, revealed a transformative view to medicine. He supported a community health approach by doctors and considered a national health system the only way forward to desegregation. He moreover endorsed the team approach where medical personnel work alongside nurses, [physiotherapists and occupational therapists] (own insertion) as 'equals contributing own expertise' (Inyanga 1983 p19).

The same 1983 edition of 'Inyanga' also records an interview with Peter Belonje, Professor of Physiology and Head of Department, and a veterinarian by profession, in which the professor noted that the Physiology course was geared towards training the basic doctor and that physiology practicals were geared towards the procedures used in everyday general practice. The student interviewer asked whether Physiology staff were 'selected' according to their credentials as scientists or as teachers and to this Belonje responded that 'the university is known for its research and consequently there is high input into research and a relatively low teaching load (...) if a lecturer doesn't do scientific research he becomes a bad teacher because he isn't keeping up to date with his specific subject' (Inyanga 1983, p20). This demonstrates the University's and the Department's emphasis on research, and the professor's conflation of the staff member's ability to teach with their ability to do research. The question was asked about differences in work load between the Physiology and Medical Biochemistry course (PMB) and the Anatomy course, to which Belonje responded that it was easy for students to 'overdo Anatomy because they enjoy it and are very good at memorising facts' (Inyanga 1983, p21). He goes on to emphasise that PMB was 'intangible' and therefore required a great deal of imagination. The challenges with conceptualising invisible processes of physiology are a reality for the majority of students (Coleman 1985, Sefton 2005). With regard to the practical orientation of the PMB course, Prof.

Belonje stated that the aims of the course were to provide students with practical, applicable knowledge; that many doctors fail to see the whole body in context and the objectives of the course was 'to educate students to see the body as a whole' (Inyanga 1983, p21).

The Departments of Anatomy and Physiology remained autonomous entities with distinctive disciplinary boundaries from the origination of the Medical School in 1912 on the Hiddingh campus and its early relocation to the present site alongside Groote Schuur Hospital up until the start of the new millennium. In 2001 the Department of Human Biology officially came into being as an amalgamation of departments possibly more appropriately described as an assimilation of the Department of Physiology within the Department of Anatomy.

I interviewed Professor Louw who was acting Head of Anatomy at the time of the merger, and enquired about the circumstances and decisions concerning the interdisciplinary merge. He suggested that the merger occurred following a directive from the then Dean of Health Sciences, Professor JP van Niekerk, to reduce the number of departments. At the time Physiology was without leadership as Professor Belonje had taken early retirement. The interim Head of Anatomy, Associate Professor G. Louw together with Associate Professor Vaughan, Head of the Division of Biomedical Engineering and Associate Professor Noakes of Exercise Science and Sports Medicine based at the Sports Science Institute (who in the leadership void was making decisions for the Physiology Department) met to decide who would head the newly formed department. It was decided amongst these three men that Vaughan would be the first Head of the Department of Human Biology, and that Physiology would move into the 'Anatomy Building'.

It was not until 2003 that the former Department of Physiology moved out of its premises into the Department of Anatomy's home base and into what is still today known as the Anatomy Building. Physiology teachers, researchers and support staff, undergraduate and postgraduate students, research and teaching equipment, library contents and other resources were relocated at this time into teaching and research spaces as determined by the anatomists (personal communication G.Louw). The newly

formed department incorporated finally Physiology, Anatomy, Cell Biology[36] and Biomedical Engineering. Exercise Science, a 1990s derivative specialisation from Physiology, and situated on a satellite site at the Sports Science Institute in Newlands, was also included in the bigger department at least nominally. While this account outlines the physical and organisational aspects of the merger, my colleagues and I remember it as an unnerving and hostile period with collegial and professional relations in tension. It remains one of the core aims of this study to reveal the consequences of the merger on the Anatomy-Physiology curriculum underpinning the clinical training programmes for rehabilitation health professionals.

UCT's Faculty of Health Sciences celebrated its centenary in 2012 with several commemorative articles in the South African Medical Journal (SAMJ) which provide an opportunity to conclude this historical context with both retrospection and prospection. Hussey and Hawkridge (2012) in a centenary commemorative piece in SAMJ acknowledge that the academic clinical research workforce has declined since the 1990s and that it is a strategic objective of the faculty to increase the number of clinical scientists (including in rehabilitation disciplines). The faculty asserts its commitment to promoting internal and external collaborations and partnerships, and that silo research should not be supported.

In reflecting on contributions that UCT made to medical science in the past 100 years, it is Saunders' perspective that the development of the *Xenopus laevis* (frog) test for pregnancy is perhaps the most outstanding early research in the medical school (Saunders 2012). It is noteworthy that this research was carried out in the Physiology Department by Professor Zwarenstein, and is indicative of the high esteem the department enjoyed and revealing also of the Physiology Department's distinctive research identity.

Considering that my study falls within a collective effort to understand educational and institutional practices which either include or exclude certain groups, it is of importance to reflect that black medical school alumni from the period 1945 to 1994 reported their

[36] Cell biology emerged from histology (microscopic anatomy), has collegial links with the anatomists, and pre-dated Physiology's move into the Anatomy Building. Physiology had its own departmental histology staff.

experiences of racial discrimination (London et al 2012). Respondents commented on the university's passive role despite purporting to be a liberal university, and many believed that UCT could have improved training conditions for black medical students. Research findings suggest that intangible forms of social exclusion powerfully re-enforced discrimination and that social exclusion was a hallmark of respondents' experiences while studying at UCT (London et al 2012).

In an article entitled 'Health Sciences turns 100' (UCT publication known as the Monday Paper, April 2012) the Dean, Professor Marion Jacobs, reflected on how the medical school has grown from one previously focused on the teaching of physicians to one comprising a wider range of health disciplines, and that the faculty was educating just under 4000 undergraduate and postgraduate students across the health spectrum:

> We have seen significant changes, modernising our curriculum, transforming our demographic profile, and substantially increasing our admissions ... (Dean of Health Sciences, Prof. Jacobs)

It is interesting to note what the faculty regards as 'significant' achievements: discourse about 'modernising'[37] refers to the move to PBL curriculum; curriculum renewal refers to the MBChB curriculum only and is not inclusive of the 'wider range of health disciplines' reported in the same article. The Dean referred to 'substantially increasing admissions' and transforming of demographics.

I interrogate the true meaning of transformation in Chapter 3 of this thesis and will argue that change does not mean transformation, that increasing admissions does not necessarily increase student participation, and that changing demographics is certainly diversification but is likely to be only a step in the complex process of real transformation.

[37] The phrase 'modernising' in reference to PBL curriculum is curious (see also Seggie 2010) since PBL as a curriculum format for MBChB was developed decades earlier (in the 1970's) at McMaster University in Canada (Turney 2007).

2.2 The rehabilitative health professions: Physiotherapy and Occupational Therapy

This study analyses the biomedical sciences fundamental to the professional Bachelor's degrees for Physiotherapy and Occupational Therapy. It is important therefore to have an understanding of what the professions entail, and what a trained practitioner does. By knowing more about the professions, the education and training of professionals can be brought into context.

2.2.1 Physiotherapy

Background and development of the profession

Physiotherapists are concerned with human function and movement, and physiotherapy is one of the largest allied to medicine health professions groups in Western healthcare (according to the Chartered Society of Physiotherapy). Physiotherapy began as a profession in 1894's Victorian England, and tracing its origins from massage provides an intriguing account of physiotherapy's association with medicine, and its gendered professionalism.

During the latter half of the nineteenth century in England there were an increasing number of professional roles for women of the middle and upper classes (Noordenbos 2002). Massage therapy provided women with a certain amount of professional autonomy and was a popular vocation. With no established training institutions, massage education was frequently provided by nurse/midwife masseuses, Swedish masseurs, or interested medical men, and in the absence of formal regulation many massage therapists were operating under false qualifications. Nicholls and Cheek (2006) report that in 1894 the British Medical Journal (BMJ) published an article which made generalised and scandalous claims that massage establishments were fronts for brothels. The article also proposed that an association should form which could properly instruct and certify proficiency in massage and so within six months of the article, four London-based nurse/midwife masseuses, in seeking to make massage a 'safe, clean and honourable profession for British women' (original text of founding members quoted in Nicholls and Cheek 2006, p2342) established the Society of Trained Masseuses. Their aim was to regulate training, registration and practice of masseuses.

The emergence of gendered professionalism, and the alignment of massage with medicine can be seen in the Society's Rules and Code of Conduct: there was to be no massage undertaken unless under direction of a medical practitioner; there was to be no massage for men (only under exceptional circumstances and at the explicit request of a doctor); advertising of professional services was only to be through medical journals; fees were to be charged according to professional rules and masseuses were to dress plainly in a uniform; practice only during daytime hours, refuse offers of stimulants at patients' homes; and after some time were to seek clinical spaces within hospitals. Students were for the next twenty years examined on 'proper conduct'. The Society for Trained Masseuses refused to accept male masseurs (men were only able to register with the Society after 1905). There was active solicitation of medical patronage (although I am reminded of the prohibition to treat men in the Society's stipulated rules) and these medical men signed approval of the aims and principles of the newly formed society (Nicholls and Cheek 2006). Being associated with medicine authenticated the practice of massage, provided moral respectability and medico-scientific legitimacy. The Society received and vetted referrals from medical colleagues and farmed out work to those therapists who were registered. Establishing appropriate and objective relationships with patients was also something learned from their medical colleagues.

During Victorian times a neurological condition known as neurasthenia developed which was related to the wearing of corsets. The early Society for Therapeutic Massage emphasised treatment of neurasthenia patients and in so doing created a niche area, or area of specialisation (Nicholls and Cheek, 2006). Treatment was underpinned by massage and movement therapy, supervision of light exercise, and engaging with the patient to enable her compliance of a medically prescribed plan for restoration of full movement. A biomechanical model began developing which gave therapists license to touch patients, massage and manipulate (on account of knowledge of how joints work), and to treat them on an ongoing basis. Practitioners were required to know specifics of movements, anatomy, biomechanics and kinesiology. The biomechanical framework facilitated advances in electrotherapy, hydrotherapy, respiratory manipulations and neurological therapies (Nicholls and Cheek, 2006). The Society of Trained Masseuses represented orthodox practice of massage and manipulation until a new overseeing

professional body, the Chartered Society of Massage and Medical Gymnastics, was set up in the United Kingdom in 1920. In 1944, the official name was declared as The Chartered Society of Physiotherapy (CSP), and so it remains today (www.csp.org.uk).

The remedial gymnastics profession had its origins[38] in the Second World War when special rehabilitation units run by physical training instructors were set up with the purpose of returning injured personnel to active duty as soon as possible. So beneficial was this approach that it was continued after the war when ex-services physical training instructors were utilised in civilian life as remedial gymnasts in various rehabilitation centres in England (Clews, 2010). The speciality of these remedial gymnasts was group instruction (a skill acquired as physical trainers in the forces) and a focus on active exercise. Remedial exercising or gymnastics took the emphasis away from injury and placed it on a back-to-work approach. In the early days the remedial gymnast profession thrived. The ex-services men initially did another six months of training for the qualification of remedial gymnast; thereafter qualification took nine months and finally developed further until training comprised two years of study with a year of placement or in-service training as it is known today, and there was a large degree of parity with the three year qualification of physiotherapists (Clews, 2010). Many remedial gymnasts went on to obtain a further qualification as a physiotherapist and as Clews (2010) points out several such remedial gymnast-physiotherapists, went on to become physiotherapists of sports clubs (for example Bertie Mee of Arsenal Football Club, who later persuaded all clubs in the top division to employ chartered physiotherapists) and England teams (football and then later cricket). In this way the physiotherapy profession became more publicised.

In England a merger of the professions was mooted for two primary reasons: firstly the National Health Service (NHS) could not support training schools of two similar professions, and secondly job opportunities for remedial gymnasts dwindled as physiotherapists started using progressive exercise therapy as a primary treatment modality. While a merger was proposed as early as 1973, the Association for Remedial Gymnasts and Recreational Therapists Ltd. was finally subsumed into the Chartered

[38] As referenced in Order of Council: Minutes of Lords Sitting March 24th 1986.

Society of Physiotherapy (CSP) in 1985[39] and formally ratified by the UK Parliament in March of 1986. The minutes of the Lords Sitting reveal an 'Order of Council to amend the Professions Supplementary Act of 1960 to reflect a merger of the remedial gymnastics profession with the profession of physiotherapy'. The House acknowledged it to be the first occasion on which a profession supplementary to medicine had 'voluntarily given up its identity and consented to what is effectively a merger with another profession in a way requiring formal ratification by Parliament'. Lord Ennals, in supporting Baroness Trumpington's motion for ratification, also suggested to the House that the professions should be more appropriately considered as complementary to Medicine rather than supplementary[40] to Medicine because the professions 'have skills which the medical profession do not have, and they are often very precious skills' (Order of Council: House of Lords, March 1986).

A change in the CSP statutes in 1978 allowed physiotherapists to treat patients without prior medical referral.

What a physiotherapist does

Physiotherapy plays an essential role in helping people to maximise movement and to achieve optimal physical function. This involves considerations of the demands of daily living, and of occupational, recreational and sporting activities. Physiotherapists prescribe exercise programmes to promote physical activity and encourage an active lifestyle which in turn contributes towards the prevention of health disorders. Physiotherapists are educated and trained to assess and treat a vast range of physical limitations and dysfunction by means of manual and electrotherapeutic techniques. In those countries where it is permitted (for example South Africa) physiotherapists who are qualified to do so may use complementary needling or acupuncture to treat clients. In several countries of Western Europe, Australia and South Africa physiotherapists are first-contact practitioners which means that a referral from a medical doctor is not mandatory and a client can directly seek treatment from the therapist.

[39]The merger extended the Physiotherapy Board to cover former remedial gymnasts enabling their registration as physiotherapists.

[40] 'Supplementary' is the term that was used by the former SAMDC and which is retained by HPCSA.

Physiotherapists treat patients, or clients[41] who could be recovering from an accident, a sporting injury or who have undergone surgery. Clients may have a wide range of conditions, for example, back pain or injuries of muscles, bones or joints; neurological disorders such as children with cerebral palsy; head injuries, spinal cord injuries or stroke; breathing disorders such as asthma; occupational overuse syndrome, or those who have recently given birth. A physiotherapist can specialise in various fields such as cardiopulmonary physiotherapy, neuro-rehabilitation, manipulative physiotherapy, sports and orthopaedic physiotherapy, occupational health physiotherapy, paediatric physiotherapy, women's or men's health or physiotherapy for older adults.

2.2.2 Occupational Therapy

Background and perspectives of the profession - Occupational Therapy

Occupational therapy was founded on the humanistic ideal of promoting well-being through occupation. It had a fore-runner in the arts and crafts movement and before the 1900s activity was used as a therapeutic medium in the treatment of mental health. Its popularity increased as a way of treating servicemen in hospital who returned from fighting in World War I. Reitz (1992 p51) in tracing the history of American occupational therapy found early records indicating that the use of '... hands, as they are energised by mind and will, can influence the state of ... health' which became a basic premise for occupational therapy's role in preventive health and wellness. American records dating from 1910, indicate suitable occupation to be a valuable agent in the treatment of the sick which idea was later broadened to include prevention by proposing that 'another purpose of occupation may be to give the patient a hobby to help render the recurrence of an attack less likely' (Reitz 1992 p50). However, the profession of occupational therapy in the USA at least was not very active in promoting preventive health between the 1920s and 1960s, concentrating solely on curative approaches, but from the 1970s onwards leaders in the profession (AOTA) regarded occupational therapists to play an active role in the promotion of health and prevention of disabilities (Reitz 1992).

What occupational therapy is and what a practitioner does is not easy to describe. I feel more comfortable leaving explanation to the insider professional herself, and for that

[41] The term 'patient' belongs more to the discourse of a medical model, while 'client' pertains more to a bio-psychosocial model of the profession. The terms are used interchangeably.

reason I include excerpts from the webpage of the Occupational Therapy Division of the School of Health and Rehabilitation Sciences at UCT where it presents the profession to prospective students as follows:

Occupational therapists believe that occupation or what people do every day has an important link with health and well-being. Illness or injury often disrupts people's ability to engage meaningfully in everyday occupations. Occupational therapists are trained to assess the person holistically, looking at all aspects of function, and analyse the environments where people live, work, play or pursue leisure activities so that they can understand how to improve function or adapt the environment in order to foster successful performance. Occupational therapy has developed various treatment modalities which enable people who have been ill, injured or disabled to recover their skills, or to develop new ones. (www.dhrs.uct.ac.za/dhrs/divisions/occu_therapy)

In other words, occupation can be understood as being occupied in all facets of life rather than a concept of employment alone and the profession is centred on occupational functionality. Occupational therapists themselves admit to there being 'complex meanings and essential ties to human wellbeing ascribed to the concept of occupation' (Joubert 2010, p22) and are described by their Professional Board as working with anyone who has a permanent or temporary impairment in their physical or mental functioning, and helping with rehabilitation of neuropsychological deficits including memory and attention as well as motor function, sensory function and interpersonal skills.

2.2.3 History and development of the rehabilitative professions in South Africa

The development of physiotherapy in South Africa

The South African Society of Massage and Medical Gymnasts was established when a small group of masseurs from Cape Town banded together with a similar group in Durban, in December of 1924; the first meeting of the Central Governing Board took place in 1925 (personal communication SASP consultant 2016). The first journal of the South African Society was published in 1929[42]. The Society changed its name to the South African Society of Physiotherapists in 1932, and then after World War II, in 1954,

[42] The journal changed its name alongside the name changes of the Society; it is today the SA Journal of Physiotherapy.

there was another name change to the South African Society of Physiotherapy (SASP) which remains current.

Originally physiotherapy training followed diploma courses based on the syllabus of the Chartered Society of Physiotherapy in the UK. Witwatersrand University (Wits) was the first to offer formal physiotherapy training. Through the establishment of a Department of Physiotherapy at the Johannesburg Hospital in the mid-1920s, the facilities needed for the creation of a diploma course were available. A three-year diploma course was drafted, based on the syllabus of the Chartered Society of Physiotherapy. Physiotherapy students were to do anatomy and physiology alongside second year medical students, they were also to do elementary physics, as well as courses in massage, remedial exercise, medical gymnastics and electrotherapy. After considerable delays the Wits Senate allowed the course to commence in 1938. It led to a Diploma in Massage, Medical Gymnastics and Electrotherapy which changed to a Diploma in Physiotherapy by 1944 (unknown author at Wits, archival material obtained from SASP). In the early 1970s the diploma course at Wits changed to a Bachelor of Science (BSc) in Physiotherapy. Currently Bachelor's degrees are offered at UCT (discussed later) and the Universities of Stellenbosch, Pretoria, University of the Free State, University of KwaZulu-Natal, University of the Western Cape and MEDUNSA (now Sefako Mkgatho University) (personal communication SASP consultant 2016, Eschbach et al www.physiopedia.com/south africa).

At all institutions physiotherapist preparation involves four years of training; the first two years are theoretical introduction and there is supervised practice from second year to fourth year. In the fourth year physiotherapy students do research projects and the remainder of the time is in clinical practice (Eschbach et al www.physio-pedia.com/south africa). After graduating with a Bachelor's degree, there is a mandatory year of community service in the public sector and once this has been completed the physiotherapist can go into professional practice and further specialisation[43].

[43] As an attempt at regulating physiotherapeutic specialisation, the South African College of Physiotherapy was mooted in the 1990s and exists on paper but has never been operational (personal communication SASP consultant 2016).

Physiotherapists in South Africa have the status of a first-line practitioner which refers to their professional capacity to diagnose and to treat a patient without the need for prior medical referral. Physiotherapists may refer a client for x-rays or to a specialist. According to the SASP (personal communication 2016), first-line practitioner status[44] was, recognised by the SAMDC in 1985, and then verified by the HPCSA in 1997.

The development of occupational therapy in South Africa

Occupational Therapy made its debut in South Africa when during World War II, two occupational therapists sailed from Britain for South Africa to establish the first training course at the University of the Witwatersrand, as well as the first Occupational Therapy Department at the Johannesburg General Hospital (de Villiers 1984, Davy 2003) followed by the Occupational Therapy Department at Groote Schuur Hospital in Cape Town in 1945 (Davy 2003).

The South African Association of Occupational Therapists (SAAOT) was established in 1945 just prior to the National Party's rise to power. Data indicate that for the first twenty two years, the SAAOT was chaired by male medical doctors or psychiatrists, and documentary analysis demonstrates that these medical men dictated what occupational therapists should or should not be allowed to know or do (Joubert 2010).

The Occupational Therapy Board was registered with the SAMDC in 1973. The board could submit (in writing) to Council matters concerning content of curricula, and could propose regulations of the profession, however prior approval from Council was always needed. Looking at the composition of the SAMDC at 1970 as typifying the apartheid era council – its composition was 83% doctors and dentists (most of whom were male), one nurse, one pharmacist and one chairman of a professional board of any of the supplementary professions (inclusive of physiotherapy and occupational therapy). So from 1945 to 1994 a council of white predominantly male doctors and dentists held control over the final content of the SA Occupational Therapy curriculum (Joubert 2010). Thus, a medical model and a patriarchal control system prevailed over the training of a predominantly female profession; research statistics from the HPCSA confirmed the predominance of white females occupational therapists prior 1994 certainly, but also up

[44] I have been unable to verify this statement either in the Act, or in the Scope of Practice Government Notice R2301.

until 2004 (Joubert 2010). As further illustration of adherence to a medical model (up until 2004, which is when Joubert's data collection ended), discourse centres around patient rather than client, around disorders and treatment rather than a 'living environment' which is the current frame of reference for the profession.

In a review of her own profession, Robin Joubert (2010) notes with concern that many occupational therapists throughout the world are still embedded in a medical model of healthcare. She feels strongly that by not taking on board models of disability, occupational therapists are alienated from the people they should be serving, namely persons with disabilities. In arguing for occupational therapy to take on an African influenced model of disability, Joubert cautions against insularity and suggests that it would be foolhardy not to prepare South African occupational therapists to be able to work anywhere in the world.

Just as in the case of physiotherapy, occupational therapy training centres opened first at the University of the Witwatersrand (1943) and then expanded over time to the other seven universities - Pretoria in 1955, Stellenbosch in 1961, University of Cape Town in 1972, University of the Free State in 1976, MEDUNSA (as it was then) in 1976, University of Durban-Westville (as it was then) in 1977 and University of the Western Cape in 1980 (Davy 2003).

2.2.4 Regulation of the health professions

The South African Medical and Dental Council (SAMDC) was established in 1928 to regulate the medical and dental professions. In time, the allied health professions established professional boards under jurisdiction of the SAMDC with the purpose of setting and maintaining professional and educational standards. With the new dispensation, the SAMDC became the Health Professions Council of South Africa (HPCSA) with a mandate to 'protect the public and guide the professions' (HPCSA Act 61 of 1974). All practicing health professionals have to be registered with the HPCSA.

During the Mbeki presidency, legislation was enacted despite strong opposition which gave the Department of Health (DOH) control of the HPCSA where the DOH appoints members to the HPCSA from a list of nominees (van Niekerk 2009). Van Niekerk (2009) reflects deep concern from a medical perspective that politicisation of the Council

resulted in the HPCSA being made up of lay persons lacking expertise and furthermore that the combining of many professions into the HPCSA with several professional boards did not follow a workable rationale. Professional Boards for Physiotherapy and Occupational Therapy were registered with the SAMDC in 1976. By way of repeal the Professional Boards of Physiotherapy and Occupational Therapy were dissolved by the Minister of Health in 2006 (Health Professions Act 61 of 1974, Government Gazette 29034 of July 2006) and the Professional Boards[45] were reconstituted in groupings as Physiotherapy, Podiatry and Biokinetics, while Occupational Therapy is grouped with Medical Orthotics and Prosthetics, and Art Therapy.

In terms of an amendment to the Health Professions Act 61 of 1974 (Government Gazette 18890 of 1998, amended finally GG 34494 of 2011)[46] both physiotherapy and occupational therapy graduates needs to do one year of community service in the public sector at a health facility determined by the Minister of Health. Registration with the HPCSA is first as a student (Government Gazette 16180 of 1994) then when doing community service and finally when the physiotherapist or occupational therapist goes into independent practice. The HPCSA made 'continuing education and training' mandatory for all registered health practitioners (Government Gazette 29716 of 2007). The more popular discourse is 'continuing professional development' (CPD) which is a requirement for health professionals worldwide (French and Dowds 2008). The ultimate goal of CPD is better patient care and healthcare professionals are required to critically review their skills and knowledge, both clinical and non-clinical. The rationale for CPD is to foster personal and professional development in order to provide best practice and meet a rapidly changing healthcare environment which presents challenges of new technologies, new knowledges, and emerging legal and ethical issues. With an increased emphasis on multidisciplinary work there is also an increased imperative on CPD for the various contributing healthcare professionals (French and Dowds 2008).

[45] Education Committees of the relevant Professional Boards are expected to do inspections every 5 years at the various universities to ensure adherence to minimum standards of training for physiotherapists and occupational therapists.

[46] Note that the Act still uses the notion of supplementary to medicine, as in 'supplementary health services professions'. The UK replaced supplementary with 'complementary' which acknowledges more independence from medicine.

French and Dowds (2008) undertook a comprehensive review[47] of professional development in physiotherapy which reflected the shift from passive learning (the 'continuing education' discourse with its connotations of didactic teaching) to active professional development (conveys self-directed, active and experiential learning) and furthermore a shift from input to an outcome-directed system. Inputs refer to the amount of time spent on CPD (points within a timeframe) while outcomes recognise the change in practice that occurs from self-directed learning. Most professional bodies continue to use the input system (French and Dowds, 2008) as does South Africa. The HPCSA implemented a CPD[48] framework which measures learning activities in time-based units. Every health practitioner has to accumulate 30 continuing education units (CEU[49]) over a one year period of which 5 units must be from human rights, medico-legal or ethics activities - the underpinning reason being an increase in malpractice claims against health practitioners mainly in private practice (Maharaj 2013).

2.2.5 Professional education: School of Health and Rehabilitative Sciences at UCT

The Departments of Physiotherapy and Occupational Therapy were established in the 1950s. All courses began as diploma courses and then became degree courses as was the national trend (de Villiers 1984).

In his 1984 honorary lecture commemorating Professor Downing's[50] contributions to developing the rehabilitative professions at UCT, The Dean of Medicine, Prof. De Villiers reflected on the state of the professions (Physiotherapy, Occupational Therapy, and Speech Therapy) in context of the national healthcare system. He openly questioned whether the country needed these sophisticated services if they were rendered exclusively to the financially privileged, and were minimally involved in community healthcare. He noted that a vast number of practitioners were in cities and peri-urban areas, and that the overwhelming majority were white, despite the fact that the greatest need existed in communities that were predominantly black and coloured (De Villiers 1984). These insightful comments were made ten years before the birth of the new

[47] Physiotherapy CPD in Australia, New Zealand, United Kingdom, Ireland, and USA were reviewed.
[48] CPD is a prerequisite for health practitioners to retain registration in terms of the Health Professions Act
[49] Note the outdated terminology inherent in 'continuing education' units even while it is located within a 'continuing professional development' framework.
[50] Prof. Downing was the previous Dean of Medicine and Professor of Medical Education.

democracy of South Africa which heralded the transformation of healthcare and health education. When apartheid ended, students from communities that were previously overlooked gained access to the university with the intention to graduate rehabilitative health professionals who would serve communities which were previously excluded.

In 2001 the Departments of Physiotherapy and Occupational Therapy became Divisions within a School for Rehabilitative Sciences. After following completely separate curricula until 2004, students of physiotherapy and occupational therapy formed a joint class for the two year fundamental curriculum of Human Biology, which was the result of the aforementioned interdisciplinary merger between Anatomy and Physiology. This foundational curriculum and the extent to which it supports integrative knowledge-building for each profession are central to my research. The reader is referred to Appendices 1.1 -2.2 (pp 229-234) for PT and OT-specific subjects; BSc Physiotherapy and BSc Occupational Therapy curricula.

Summarising the distinctive features of the disciplines and of the professions

Anatomy (gross or morphological) is essentially a static field with no breakthrough new knowledge. Developments are largely in the way that anatomical features are viewed - for example by MRI or enhanced X-rays. Learning from cadavers has long been a feature of anatomy; disciplinary knowledge does not come about by integrating basic scientific principles thus anatomy requires entirely different teaching, learning and curricular strategies than does physiology. Physiology earned its autonomy from Anatomy in the late 1800s and is distinctively characterised as an experimental science. Basic chemical and physical principles can be demonstrated in the laboratory which developed into a critically important pedagogical space for undergraduate and postgraduate students. Physiology knowledge continues to grow cumulatively thereby integrating and building on prior knowledge. New knowledge is developing exponentially creating challenges for teaching and learning alike. Physiotherapy is distinguished as a hands-on profession where massage, electrotherapy, ultrasound, laser and mobilisations are used to treat dysfunction or injury. PT is based on a physiological understanding of tissue repair, healing, pain, movement, and cardiovascular, pulmonary and musculoskeletal functioning. OT is characterised as a humanistic profession which is focused on restoring the client to occupational functionality with much emphasis on psychosocial wellbeing.

CHAPTER 3. CONCEPTUAL FRAMEWORK - ACCESS, KNOWLEDGE AND CURRICULUM

My study is embedded in a collective research effort (outlined in Chapter 1) looking at various aspects of social inclusion in higher education. In this chapter I unpack the concepts of equity, inclusion or exclusion, and access in context of the transformative agenda in higher education. Then, because disciplinarity, knowledge and curriculum are central issues of my research, I consider the intricacies of these concepts and discuss the key debates. The aim of the chapter is to prepare the reader for discussions further in the thesis where I explore how these concepts relate directly to my research context.

3.1 Transformation in Higher Education: equity, access, exclusion, inclusion

The Department of Education White Paper of 1997, envisioned a transformed, democratic, non-sexist, non-racist system of higher education (HE). Given South Africa's apartheid past, the call for higher education to transform itself was at the same time a call for higher education to contribute to the transformation of society (Morrow 2009, Scott et al 2007, Badat 2009). Policymakers imagined that a transformed higher education system would play a critical role in producing critical, independent citizens as well as skilled and socially committed graduates who would be capable of contributing to social and economic development in an emerging democracy (White Paper 3 1997, National Plan for Higher Education 2001). From the start there was a tension between trying to bring about fairness and justness in the system and at the same time facilitate socio-economic development. While the earlier HE related policies focused extensively on notions of transformation, equity, access, redress and democratisation, the more recent national documents seem to privilege efficiency discourses and managerialism (Lange and Luescher-Mamashela 2016). Organisational restructuring of faculties, schools and departments mirrored a new managerialism[51] in the South African higher education sector from 2001 onward (Lange and Luescher-Mamashela 2016) and it was in this environment that the Departments of Physiology and Anatomy were restructured to a single Department of Human Biology at my research site. Similarly a School of

[51] This was a global trend and not unique to SA (Lange and Leuscher-Mamashela 2016).

Rehabilitation Sciences encompassing Divisions of Physiotherapy and Occupational Therapy rather than autonomous departments was established. Central to my study are changes that have occurred at curriculum level and the potential effects that these may have had.

Fourie (1999) distinguishes transformation as being a complete alteration of the form and nature of institutions, and includes cognitive transcendence to a fundamentally different way of being and thinking[52]. Institutional transformation requires taking account of structural or governance issues, demographics, core functions of the university (teaching and research), and organisational culture which is about values, norms, and behaviours and is shaped by the people in the organisation. Institutions have differentially responded to global trends such as the rise of managerialism and the 'decline of collegiality and academic rule' (Lange and Luescher-Mamashela 2016, p111). The transformation discourse in the context of South African higher education has, for the last twenty years, tended to be associated primarily with demographic changes in the composition of students and staff[53]. However, changes in terms of numbers without transformation of institutional culture and practices, is not conducive to harmony and cannot be considered to have created an equitable climate for higher education. More complex and nuanced understandings of transformation incorporate change in institutional culture to address inclusiveness, diversity, redress, racism, sexism (patriarchy), all of which are about the development and acceptance of new shared values, which can only be achieved through fundamental changes in the mindset of all role players (Fourie 1999, Webbstock and Fisher 2016). No university can be called transformed if exclusionary practices and marginalisation continue to exist for its staff and/or its students.

Central to notions of transformation are ideas of inclusion, exclusion, equity and access. While inclusion denotes being a participant in, exclusion effectively precludes individuals or groups from full participation. Prevailing structural conditions, ideologies, policies and practices determine just who will enjoy access and whether exercised singularly or

[52] In these ways transformation is different from reform, which is a process of modification without fundamental change.

[53] Academic staffing in the historically white universities remains predominantly white and male (CHE review 2016).

collectively these determinants have the capacity to marginalise certain groups and exclude them from accessing resources (Sayed et al, 2012). As an example of such practices and arising from a study of gender-based exclusion at UCT, Shackelton et al (2006 p579) found there to be 'complex gendered forces underlying organisational norms'. A highly gendered institutional culture is by no means only a South African problem. A Nigerian study reports that women at university experience 'subterranean[54] ways in which power is relayed in everyday practices' and that these dominant power relations determine what gets taught and what gets excluded (Odejide et al 2006, p554). Deep transformation of South African higher education around gender issues requires fundamental change in the institutional culture rather than just a focus on numbers[55] (Shackelton et al 2006). Exclusion works in various ways and along intersecting lines of gender, race, socio-economic status and numerous other identifiers (Jansen 2004, CHE review 2016).

In education, exclusion can mean 'to be excluded from good quality learning' and even in institutions 'premised on equal opportunity', multiple sources of inequality and marginalisation may exist (Sayed et al. 2012, p17). What is written into organisational and institutional policies is often a world apart from what is implemented. Educational systems are always linked to wider societal processes and therefore exclusion in education is a facet of exclusion in society. When universities seek to address issues of exclusion in the name of transformation they need to reflect on how they are mirroring exclusionary forces from outside and what power they might have to address them from within.

The desire to form more inclusive universities comes from the underpinning value of equity. Equity is a complex concept - equity touches peoples' belief about fairer societies, social change and development and touches hopes and aspirations of families and individuals (Bitzer 2010). For many, the notion of equity in higher education means fairness, equality of opportunity, and greater parity between composition of the

[54] This refers to a 'hidden curriculum of often unspoken but nevertheless important messages which are transmitted within the Higher Education establishment' (Odejide et al 2006).

[55] At UCT in 2003 women made up 7% of the professoriate and 70% of assistant lecturers (Shackelton et al 2006). These statistics were below the earlier 2001 National level where women comprised 10% of the professoriate, and 48% at lecturer or below, and also below Nigerian figures for 2003 where 13% of professoriate and 40% of assistant lecturers were women (Odejide et al 2006).

university and the national population. The objective of equity therefore is that all groups in society have the opportunity to participate successfully[56] in higher education.

One of the key points with which universities have to grapple is an issue of equity in respect of admissions and enrolments. The advent of democracy in South Africa in the mid 1990's enshrined a constitutional right to an education and this imperative meant that all Higher Education Institutions (HEI) had to address exclusionary admissions policies and respond by opening (or widening) access. Indeed, one of the most obvious achievements in a post-apartheid South Africa has been the significant increase in formal access which has shifted the demographic profile such that most higher education institutions now have a majority of black students (Scott et al 2007, Scott 2009, Ballim et al 2016).

After World War II there were broad social, political, cultural and economic changes which brought about massive growth (massification[57]) of education in wealthy nations (Christie and Maton 2011). There were also transformations in technology, work, and society which resulted in proliferation of sites of knowledge production beyond the academy. Production of knowledge was thus no longer the preserve of the elite, and the 'mystery of knowledge' was now more public (Wheelahan 2010, p152). Thus over the past decades there has been massive growth in formal access to higher education and while admissions have taken a particular focus in the post-apartheid South African context, the matter of widening access is an international one (Maton 2004b, Christie and Maton 2011). In South Africa, massification of higher education from 1995 onwards meant that a bigger proportion of students from educationally and financially deprived backgrounds were admitted to historically advantaged HEIs such as UCT. Admissions on academic merit alone which had more salience in the elite era, are not attainable in mass higher education systems, and even more so in the South African context where huge inequities in the schooling system remain (McKenna 2016).

In South Africa, equity of access is hampered by inequalities in the primary and secondary school system which mostly affects aspirant black university students and unless all education sectors function more effectively there can be no equity (Scott et al

[56] The term success has its own trajectory – differentially nuanced dependent on context.
[57] Massification refers to increased participation in higher education by larger sections of the population.

2007, Mckenna 2016). Given the increase in student numbers, many of whom are regarded as non-traditional students, the last decades has seen the introduction and strengthening of academic development programmes[58] (otherwise known as bridging- and foundational programmes) in efforts to improve equity of outcomes for black students (Mckenna 2012). Current data show that black students continue to take longer than the regulation period to complete their qualification, or fail to complete their studies altogether. The success rate in higher education is thus skewed by race and prior education, and the sector as a whole is still characterised by high attrition (Scott 2009, Boughey and McKenna 2015, Cloete 2016, McKenna 2016).

School completion and school achievement are closely related not only to race but also to social class and people of low socio-economic status[59] (SES) are highly under-represented in higher education generally. In a series of debates at UCT in 2009, the university argued for maintaining its policy of race classification as a stated admissions criterion while respondents in the debate opposed racial admissions as morally indefensible; for increased equitable access, Bitzer (2010) argued for offers of admissions (at UCT) to be extended to low SES students of all races. Recent student protests demanding free university education stem from the idea that fee-free education will improve equity. This assumption considers cost to be the principal barrier to access, and that removal of the barrier to access will promote equity. However, equity can only be achieved by taking into account the 'building of possibilities and choices, raising aspirations, and boosting personal educational achievement' (Bitzer 2010, p305). Morrow (2009) regards educational achievement[60] as indicative of a level of participation achieved by the student, reflecting their development as learners of the practice.

To understand why achievement is important, one should be clear on what higher education means and represents. Morrow (2009) considers the distinctive knowledge of

[58] The intervention programme (IP) for physiotherapy and occupational therapy first year students at UCT was implemented in 2009.

[59] Given the legacy of apartheid, race still correlates strongly with socio-economic class, despite the emergence of a black middle class.

[60] Morrow distinguishes academic achievement from educational achievement. He argues that academic achievement demonstrates an assured understanding of the academic practice and reflects how well someone has engaged in an academic practice by for example authoring journal articles, books, or theses.

higher education to be knowledge that is not readily accessible, even in an information-saturated society, networked on information technology. This kind of knowledge is typically attained through a process of systematic and guided learning building on an 'already achieved mastery of more elementary kinds of knowledge' (Morrow 2009, p117). Higher education is defined in terms of this kind of knowledge, called 'higher knowledge' by Morrow, and 'powerful knowledge' by others (Young 2013, 2014, Wheelehan 2007, 2010). Higher knowledge is a catalyst for innovation and a potent source of growth and development. The reason it is valued in modern society is because it is perceived to be a public good, of general benefit to society, and access to higher education is thus a matter of social justice. Higher knowledge is however a socially constructed domain (discussed in the next section) which makes it vulnerable to powerful market forces and political pressures and is therefore much more fragile in some societies than in others (Morrow 2009).

Much education research absents a focus on knowledge and therefore does not make the crucial link between the role of knowledge and a socially inclusive education system (Moore and Young 2001, Maton and Muller 2007, Maton 2010). There is also little research into the way that particular forms of knowledge are positioned in curriculum, and the ways that students come to engage with, or access these forms of knowledge (Ashwin 2014). The term social inclusion is much bandied about in higher education circles, yet seldom contextualised with how knowledge practices may include some groups yet marginalise others. As an experienced teacher in the Sciences, I have witnessed over many years just how hard it is for first year students to gain entry into a scientific way of thinking and to acquire knowledge of basic principles. The complexities of science would seem to be especially challenging for those students who enter the university inadequately prepared by their educational background and social circumstances. While exclusion is multi-faceted this research focusses on how curriculum organisation per se may exclude certain students from powerful knowledge.

The constitutional right to an education meant that all Higher Education Institutions in South Africa had to respond by opening (or widening) access. This kind of formal access is about physical entry and refers to being able to register for courses, attend classes, and reside at an institution of higher learning. However, broadening access does not in

itself lead to increased output or qualifications; and not all students who gain formal access to HE will be equally successful in gaining access to higher knowledge. Following formal admission students need to engage with the knowledge of the academic programmes for which they have registered and to be supported in doing so. In other words, registration as a student at university is no guarantee of gaining access to the knowledge that the university distributes – epistemological access.

Epistemological access is a term attributed to Wally Morrow and he defined it as learning how to become a successful participant in academic practice (2009). Participating in academic practice is a long term project requiring systematic learning of the standards of the practice, complemented coaching or mentoring by experienced people who understand the practice. Morrow emphasises that learners need to play their role in achieving their own epistemological access, acknowledging the authority of the practice and its outstanding participants. Epistemological access requires time and effort and cannot be supplied or delivered to the learner; it cannot be transmitted automatically to those who pay their fees or attend class (Morrow 2009). Several factors can contribute to the likelihood of a learner's epistemological access; for example mediating between the different cultural backgrounds that students and lecturers may respectively draw on, which could include linguistic development and making overt the academic context and what counts as appropriate knowledge (Boughey 2005, Boughey and McKenna 2015). Further contributors to the likelihood of epistemological access are the standard of prior schooling, an enabling institutional culture, access to good textbooks, guidance by good teachers[61] as well as appropriate assessment processes and good curricular design (Jansen 2004, McKenna 2012, Morrow 2009). The challenge of widening participation has not yet been met and is likely to remain a major issue for the higher education sector (McKenna 2016). In terms of student success, it is imperative that completion rates should be substantially improved for all students but 'particularly for the historically most disadvantaged groups that is African and coloured students' (McKenna 2016, p145).

[61] The appropriate relationship is needed between learners and teachers if teaching is going to contribute to learners' epistemological access. Teaching loses its point if it fails to attend to the requirements of the practice; and it fails to acknowledge standards of achievement of the practice (Morrow 2009).

There is a clear (and consequential) distinction between formal access to the institution and epistemological access to the knowledge practices and discourses of the academy. Epistemological access is thus about democratic access to knowledge – it explicitly foregrounds knowledge, its various forms, how it is organised, its value bases and its power. This assertion about the differentiatedness and power of knowledge prompts an overview of what these various forms and organisation of knowledge may look like. Because epistemological access is about participation in academic practices or disciplines, I will first elaborate these socially-constructed domains which constitute the macro organisation of knowledge.

3.2 Academic Disciplines: fields of specialised knowledge and knowledge communities

A key component of my study is an investigation of the disciplines that are considered fundamental to physiotherapy and occupational therapy. It is necessary therefore to understand the conceptualisation of academic disciplines (or academic practices as Morrow (2009) will have it) and all that they embody. At my study site, as described in Chapter Two, the disciplines regarded fundamental to medicine, physiology and anatomy, were merged and hybridised to a form that may or may not constitute interdisciplinarity, a concept which I expand upon in this section.

3.2.1 Disciplinary knowledge and culture

The disciplines represent knowledge fields with their own knowledge communities. Bernstein (2000, p52) regarded the traditional disciplines as 'singulars'[62] each with a unique name and 'specialised discrete discourse of intellectual texts, practices, and rules of entry'. Becher and Trowler (2001) regarded disciplinary groups as 'academic tribes' each with their own intellectual values, disciplinary practices and modes of enquiry.

Disciplines are generally well defined and strongly bounded (Moore 2011). Bernstein (2000) regarded a discipline's strong boundaries and hierarchies as a protective means to orientate its own development, so that the addition of new knowledge takes place in alignment with the existing norms and values of the discipline. Each discipline has its own cognitive territory and unique set of epistemic regulations which govern the

[62] Bernstein (2000) normally categorises the knowledge structures that underpin professional knowledge not as singulars but as regions.

concepts, methods and arguments of the discipline (Muller and Young, 2014). Disciplines control standards for graduation (Muller 2011). Disciplines embody knowledge that has built up over time in stable communities with their own rules for internal self-regulation, and leads to the most reliable knowledge we have at any one time (Christie and Maton 2011, Muller and Young 2014). Each discipline thus has its own disciplinary culture which transcends institutional and national boundaries, enabling transcontinental communications and collaborative enquiry. Information and communications technologies have opened up new possibilities for accessing knowledge and sharing data and research, and disciplinary communities are now properly global (Maton and Muller 2007). Disciplines provide a key basis for identities between academics, and between the discipline and the institution. Disciplinary identities are relatively stable and long term (Moore 2011) and involvement with a discipline can invoke a sense of belonging (Christie and Maton 2011).

Biglan (1973) distinguished between 'hard'[63] and 'soft' disciplines, which differ in the degree to which they do or do not operate within a paradigm or consensus within a scientific field. Scientific knowledge, for example, grows cumulatively by ever more abstract and general propositions (thus, progressive abstraction) and complex paradigmicity. Biglan also developed a concept of pure and applied disciplines. The applied disciplines deal in pragmatic and useful knowledge towards a worldly goal and the primary aim is to produce practitioners (Muller 2009). Becher (1994) characterised the disciplinary culture[64] of 'hard, pure' disciplines as being 'competitive (and) gregarious' with research outputs measured by high numbers of publications. Such disciplines, according to Becher, are socio-culturally typified by a team of tenured staff, post-doctoral fellows, doctoral students, technicians, and involved in expensive research often requiring outside funding and thus demanding of social relevance. For example, physiology possibly typifies a hard, pure discipline with its associated culture; although with its direct application to medicine, it also may be regarded as an applied discipline.

[63] Muller (2009) asserts that Biglan was not the first to use these terms.

[64] Becher's 1994 adaptation of his 1987 work - the cultural manifestations of the different types of disciplines as described by Becher are not without contestation.

On the other hand 'soft pure' disciplines have, according to Becher (1994), a loosely structured individualistic culture built around a solitary researcher, with low numbers of publications, without demands on apparatus and not requiring the different tiers of staff and students described in 'hard pure' disciplines. The 'hard, soft, pure, applied' categorisation of epistemological differences has been criticised as presenting an overly structured account of disciplines, one which does not take into account that the forces on higher education have shifted from the discipline to the state, and the market. Furthermore, this approach arguably underestimates the scope for academic agency and disciplinary culture in shaping knowledge in teaching, learning and assessment (Mathieson 2012).

Disciplines developed over long periods of time through systematic and disciplined enquiry in search for truth and knowledge. These practices comprised communities of enquirers which collectively, and often competitively, wanted to discover or find out what is true. Academic practices depend for their continued flourishing on being maintained in and by communities of participants (Morrow 2009). Disciplinary cultures impose their own particular pattern in research, and in teaching and curriculum. Mathieson (2012) argues that disciplines should be considered as socially situated practices where academic agents can respond to prevailing socio-political and contextual factors. Academic teaching, learning and assessment cultures embrace different values, different approaches to teaching and learning, different relationships between academics and students, and different relationships between academics engaged in and delivering curriculum (Mathieson 2012). These disciplinary cultures are developed over time in response to varying institutional and disciplinary contexts, and academics have developed deeply invested identities. Becher (1994) cautions that an awareness of different disciplinary cultures and different disciplinary epistemologies is relevant to policy development, faculty development and to curriculum design.

Within the sciences, application or relevance is increasingly prized (Muller 2011). This has given rise to a rift between 'pure' and practical 'applied' disciplines which has influenced curriculum and the pattern of disciplines in the contemporary university with 'new regions of interdisciplinary enquiry' periodically opening up (Muller 2009).

3.2.2 Politics of academic practices – challenging disciplinarity and interdisciplinarity

The guiding ideal of academic institutions is to constitute the realm of academic learning and to provide an institutional home for academic practices (disciplines) and access to them (Muller 2009, Young 2010, Wheelahan 2010). Morrow (2009) reminds us that academic practices have developed around the universal aspiration of people to know and understand themselves and the world, and that academic practices are known as 'disciplines in terms of which it is possible to think rigorously'. I have shown (in Chapter 2) how academic practices and disciplines were socially construed during history. Disciplines demand particular ways of thinking and refute others; they determine what counts as knowledge and who counts as knowers. This is used by some to say they serve a particular group or have sectional interests. In South Africa the social and historical foundations of disciplinary knowledge have been linked by some to a colonial white elitist past (Mathieson 2012); there are however more nuanced viewpoints such as Morrow's for example which suggests that academic practices might also be viewed as essentially transcultural. Disciplinarity and the move towards interdisciplinarity are equally hotly contested domains as is outlined in the next section.

In the world of university politics, academic disciplines tend to develop hard boundaries to preserve their status and defend their cognitive territory; and in this way academic disciplines can lose their 'disciplined flexibility' and close themselves off from potentially generative mechanisms from other disciplines (Morrow 2009, p131). In Chapter 2, I reviewed how physiology globally, and since its inception at UCT, was closely aligned with medical biochemistry. As a course for medical students at UCT it was known as 'Physiology and Medical Biochemistry' and was retained as such until the late 1990s. This demonstrates Physiology's flexibility and openness to generative, developmental and growth potentials. Academic practices change over time, but not simply as a result of a decision by any individual or local group of participants. Any refinements or revisions, according to Morrow (2009), would have to be justifiable in terms of the intrinsic standards of the practice and the relevant academic community would have to acknowledge that the proposed refinement or revision is indeed an improvement of the academic practice in question.

In tracing the origins of an interdisciplinary approach, Moore (2011) points to the rapid expansion of education after World War 2, and that with all these new students, there were calls for new ways of educating (Christie and Maton 2011). Disciplinarity was equated with elite forms of thought and education that excluded many (Christie and Maton 2011). Beginning in the 1960's a group of scholars in the United Kingdom and the USA, worked to construct school curricula as an integration of multiple subjects rather than having a school curriculum based on subjects derived from the disciplines (Beane 1995, Moore 2011). The organisation of school knowledge as teacher-centred, subject based curricula was seen to reflect broader societal inequalities of power. With this argument traditional disciplinary knowledge structures were seen to serve the interests of the privileged or advantaged and to work against the disadvantaged who the interdisciplinary movement championed (Moore 2011). The New Sociology of Education movement of the 1970s advocated that coupled to interdisciplinarity[65] its account of the social construction of knowledge (social constructivism) be realised in school curricula as a radical breakaway from the traditional ways of curriculum and education (Moore 2011). In this way, it was thought that social inequalities in education, and under-achievement of working class scholars, would be mitigated. The tendency was to associate interdisciplinarity with freedom, and disciplinarity with constraint (Freebody and Muspratt 2008).

Interdisciplinarity was viewed as egalitarian, while disciplines were viewed as hierarchical and elitist, as inflexible to change and as social constructs with no due recognition for the autonomy of knowledge (Moore 2011). Social Realist researchers of education dispute this approach and understand the disciplines to be socially and historically constructed, knowledge-defined, and believe knowledge integration and abstraction requires delving deeper into the disciplines, not absenting them (Moore 2011, Muller 2011, Young 2013, Muller and Young 2014, Wheelahan 2007, 2010). Several also argue for the safeguarding of disciplines as a domain for knowledge production because this is 'where the conceptual breakthroughs are distilled into the

[65] Interdisciplinarity occurred at sites undergoing rapid change as in the 1960s – 1970s in the UK where the school leaving age was raised, which required attending to teaching the non-academic scholar (Moore 2011).

evolving canon and transmitted to new generations of students' (Muller and Young 2014, p134).

Post 1994, South Africa underwent extensive social change, calls were made for disciplinary knowledge (mode 1) to be replaced by knowledge that is more applied, more relevant and more focused on world problems (mode 2) (Gibbons 1998, Jansen 2002). Post-apartheid policy saw a shift from disciplinary departments to interdisciplinary schools and programmes across many universities (Fourie 1999, Mathieson 2012). The Department of Education of the 1990s strongly endorsed the trend in education towards interdisciplinary work, and integration in curriculum was viewed by many as desirable (Ensor 2003, Muller 2009). For example, there was frequent modularisation of learning content in attempts to promote mobility of learners; and there was a tendency to organise curricula into academic programmes of study which were required to demonstrate relevance to socioeconomic needs. This precipitated a shift from disciplines which were based in departments to programmes[66] presented across departments, faculties and possibly institutions; and required a mind shift from a disciplinary approach to an interdisciplinary approach (Fourie 1999). Disciplines responded by hybridising into some form of coalition centred on a notion of relevance, perceived by some as a means to achieve pedagogical good (Moore and Young 2001, Moore 2011). In professional areas where knowledge from several disciplines is used in solving particular problems, there was a tendency to interdisciplinary work, for example in nursing (McNamara 2009). A discipline's traditional power weakens, as does its autonomy with dissolution of disciplinary boundaries (Muller and Young 2014). Muller (2011) argues that if the formative core of the discipline is lost then the interdisciplinary teaching programmes become a disconnected ensemble of segments of disciplinary structures, yet on the other hand disciplines may retain an identifiable shape and identity within the teaching activities of the interdisciplinary programme.

[66] Muller (2009) claims that academics in strong institutions with strong academic identities located in strong disciplines or regions had the wherewithal to resist programmes. Fourie (1999) reported that staff were unsure of their role in the design and implementation of programmes and had real fears regarding the survival of their disciplines in the new dispensation.

Over the past ten years in the SA Higher Education sector there have been several institutional mergers which have given rise to departmental or disciplinary mergers and in so doing have created interdisciplinary spaces. Mathieson (2012) reports from her research (at South African historically white and historically black universities) that there are intense struggles about key issues of teaching and learning in the process of a merger. Disciplinary teaching, learning and assessment (TLA) communities responded differently to factors such as learning challenges of educationally disadvantaged students; the needs of industry plus workplace expectations of graduates; or a change in disciplinary knowledge relevant to a society in transition from its apartheid past. In traditional departments, disciplinarity is a very powerful factor influencing teaching and learning practices while departments that valued the discipline but also sought to change knowledge and curriculum in response to contextual issues, responded with more flexibility. Following mergers the perception was that academic agency in shaping culture was curtailed to the detriment of teaching and learning quality (Mathieson 2012). Concerns were raised about quality and standard where disciplines were seen to be subordinated. The strength of disciplinary allegiance was thus central to conceptions of quality in disciplinary teaching, learning and assessment cultures. Mathieson's research revealed a recurrent perception of the threat to the integrity of the discipline and the quality of teaching and learning from bureaucratic managerial efforts to impose change.

The pressures on disciplines towards interdisciplinarity are based not only on questions of relevance but also economic rationale (Christie and Maton 2011). A further challenge to the disciplines, especially the basic sciences, comes from outcomes-based or problem-based curriculum reformers67 (Muller and Young 2014). Emphasis on outcomes and skills arose as a driver to make the university more efficient, to make learning more practically meaningful to the student, and to prepare the student for the job market (Beck and Young 2005, Muller and Young 2014, Wheelahan 2010). Generic skills and competencies were written in to medical programmes and related to professional knowledge (Beck and Young 2005). In the South African context a shift away

[67] Curriculum reforms including PBL, which was implemented in the MBChB programme at UCT in 2002, have been previously referred to in Chapter 2 (Seggie 2010) and are further discussed and critiqued in this Chapter (section 3.5)

from disciplinary knowledge (mode 1), is represented by case- or problem-based curricula, or an Integrated curriculum (Mathieson (2012).

Christie and Maton (2011, p1) bring attention to the reality of living in an era where technical innovations, new information technologies and communications are 'democratising the creation of knowledge and undermining traditional notions of scholarly authority'. Consequently there is a tendency towards the dissolution of boundaries between the academic disciplines and the world beyond academia. The role of boundaries is an important consideration in building knowledge, and I explore this further in the next section.

3.3 Differentiated Forms of Knowledge

Knowledge is differentiated. There is a continuum from non-specialised, common sense, everyday knowledge to specialised, scholarly knowledge. Non-specialised and specialised knowledge serve different purposes. Bernstein (2000) differentiates these forms of knowledge as being realised in horizontal and vertical discourses. The former comprises every day, common-sense, mundane knowledge which is directed to immediate goals in the context of the acquirer's life. This form of knowledge is tied to particular contexts (e.g. sports clubs, home), is understandable only within the specific contexts, is consumed by the context and cannot readily be applied elsewhere. This makes mundane knowledge culturally segmented, and that is why it is difficult for mundane knowledge to be the driver of change beyond the context in which it is enacted (Wheelahan 2010).

The vertical discourses (Bernstein 2000) of specialised knowledge, on the other hand, are traditionally produced in universities and research institutes and are what Young (2013) refers to as 'powerful' knowledge, the acquiring of which allows alternative possibilities to be thought. Such knowledge is valued as an enabler of social mobility because university qualifications can lead to better employment and other opportunities, and it also potentially allows the development of solutions to social ills. Powerful knowledge is thus at the same time a private good and a public good.

3.3.1 Distinguishing powerful knowledge

Vertical discourse is variably known as abstract, conceptual, esoteric, theoretical or powerful knowledge. The specialised knowledge of vertical discourse is differentiated from everyday knowledge because it is generalisable knowledge which is not tied to context. It enables one to transcend the everyday, and which allows one to think the 'unthinkable', the 'not yet thought' (Bernstein 2000, p31) and to consider alternative possibilities, and imagine other futures (Wheelahan 2010). Such theoretical knowledge is the site for 'society's conversations about itself' (Wheelahan 2010, p37). Such knowledge has power and status. According to Young (2013) powerful knowledge is knowledge with powers and it is powerful because it provides the best understanding of the natural and social worlds that we currently have. Powerful, theoretical knowledge is typically organised in disciplinary frameworks (Bernstein 2000, Beck and Young 2005, Morrow 2009, Muller 2009, 2011, Wheelahan 2007, 2010).

Access to powerful knowledge in all its diverse forms is a right[68] for all students. As educators we need to be cognisant of how powerful knowledge is acquired, and why the extent to which a curriculum is underpinned by powerful knowledge is both an epistemological and a social justice issue (Maton and Moore 2010, Young and Muller 2010, Young 2013). Access to powerful knowledge is always regulated by distributive rules which provide access to some and not to others (Wheelahan 2010).

Vertical discourse has, according to Bernstein (2000), two forms of knowledge which are differently structured. There is a form comprised of a series of specialised languages, which Bernstein calls horizontally structured knowledge and which is exemplified by the Humanities. There is also a hierarchical form of knowledge, exemplified by the Natural Sciences, which is organised according to coherent, explicit, systematic principles and which attempts to create very general propositions and operate at more abstract levels by integrating knowledge and meanings at lower levels. Bernstein (2000, p164) regards the integration of meaning to be reliant on 'mastering the procedures of investigation,

[68] Morrow (2009) distinguishes 'right' from 'entitlement'. Ambivalent use of the term 'education' to mean the entire system (of institutions that distribute knowledge) and also the process of acquiring knowledge collapses the distinction between formal access (which is the *entitlement* to register at an institution) and epistemological access (which is *not an entitlement*). Epistemological access is in part dependent on what an agent does; it is not an entitlement that can be supplied.

observation, and understanding the theory' and that acquiring a certain perspective or gaze is also necessary. The purpose of higher education is to induct students into vertical discourses, whether the knowledge be horizontal or hierarchical in nature; and that makes it critical to 'induct students into systems of meaning' (Wheelahan 2010, p37). In the next sections specialised knowledge will be further characterised. The relationship between knowledge forms and educational accessibility is also explored.

3.3.2 Different forms of specialised knowledge – what knowledge does

Broadly speaking there is a distinction between conceptual, propositional knowledge and what is often called practical or contextual knowledge. Winch (2013) refined these distinctions and expanded on the ideas introduced by the philosopher Ryle to describe knowledge forms essentially as Know That (KT) and Know How (KH):

- Knowledge that (KT) is propositional (facts, concepts, theories)
- Knowledge how (KH) is procedural (acting on, processing and management of knowledge)

In higher education, knowing just isolated facts is not enough – students need to do things with knowledge, so acquiring both know how (KH) and the ability to act on the knowing that (KT) is crucial. This suggests that between the knowledges, linkages exist which need to be operationalised and navigated. What this means is elaborated below where knowledge forms are further characterised.

Propositional knowledge is about propositions and theories, concepts and facts. Any particular concept fits within a constellation of related concepts and for there to be real understanding concepts need to be linked and connected. The student accordingly needs to know how to do something with the propositions to take knowledge further. Doing things with knowledge is at the heart of the educational enterprise (Evans et al 2010, Muller 2014).

Procedural knowledge (knowledge how) is knowing what to do with knowledge, and implies recognition and realisation of how to act with basic concepts (Morais et al 1992). Winch (2013, 2014) elaborates three kinds of know how (knowledge as practice):

First is inferential know how, where the learner grasps the relations between concepts, has the ability for connecting and linking concepts and for negotiating the 'reach' of propositions (Muller 2014). Understanding comes by first knowing the basic concepts. Secondly, there is procedural know how (at times known as practical knowledge) which refers to a procedural ability for knowledge management where a learner knows how to apply knowledge learned, find out what works in what circumstances, formulate solutions from knowledge in action, judgements are made in practice. Management and application can come about only by first knowing the propositions and basic concepts. Thirdly there is personal know how (Muller 2014) or know how by acquaintance or association (Winch 2013) where learning can be tacit, through the senses, and is not embedded in any particular discourse. In the context of my study it could refer to how students become acquainted with cadavers in the anatomy dissection laboratories: just by being in such an environment the student will learn certain things tacitly. In the case of physiology I understand this to mean that a student purely by being in a laboratory environment in the presence of experimental equipment, hearing scientific language, and by observing researchers and research procedures can acquire certain knowledge.

From this account, the inter-connectedness between knowledge that and knowledge how becomes apparent. Muller (2014, p10) argues that 'propositional knowledge without procedural knowledge is inert, procedural knowledge without propositional knowledge is blind'. Muller's word 'inert' conveys the futility of knowing only isolated facts without the ability to scaffold and build conceptual knowledge; likewise, the futility of attempting to operationalise while being 'blind' to the basic propositions that underpin the practice.

Procedural knowledge works on propositional knowledge. This has crucially important imperatives for sequencing and order in the logic of curriculum design. Within propositional knowledge it has already been stated that the learner's understanding comes from first knowing basic concepts and then using inferential ability to reach for, and link to other concepts. Acquiring the basics before second order or third order knowledge can be developed is suggestive of a hierarchy (Bernstein 2000). Similarly procedural 'know how' is hierarchical knowledge where firstly basic skills or procedures need to be acquired before higher order knowledge (skills or procedures) can be

developed (Winch 2013, 2014, Muller 2014). Know how knowledges are cumulative knowledges (Muller 2015). All knowledges have procedural knowledge – it is not only the domain of vocational or professional training and education (Muller 2014).

The case for professionally-oriented knowledge

The purpose of professionally-oriented programmes is to prepare graduates for competent practice in the world of work. Professional knowledge underpins the authority of the different professions. Professional identity is built around the practice, what the professional or practitioner can do, and what the practitioner can do refers to specialised skills which depend on specialised theoretical knowledge (Morrow 2009, Muller and Young 2014). It is argued that strong professions have strong knowledge bases (based on the disciplines) as well as strong professional communities; there is autonomy and stability, and a strong social base in the organisation of such professions (Muller 2009, 2011). Traditional professions like Medicine (and its occupational niches like nursing) have over time developed stable ways of determining and updating the knowledge base of the profession.

In the context of professional or occupational knowledge, Wheelahan (2010, p21) argues that 'learning contextually specific applications of knowledge rather than the disciplinary system of meaning in which it is embedded', ties that knowledge to the context; it does not leave students with the conceptual tools they need in other contexts or to select different applications of knowledge in the same context. The growing complexity of work requires use of increasingly abstract theoretical knowledge. Students need access to generalised, theoretical, powerful knowledge to equip them to shape their field of practice by questioning and critiquing the knowledge base of practice and the relationship between knowledge and practice (Muller 2009, Wheelahan 2007, 2010, Winberg et al 2013). A focus on the system of meanings and its relational connections also equips students with the capacity to use knowledge in new and creative ways in a variety of contexts, and to understand the relations between different fields of knowledge and appreciate the criteria used in different fields to judge knowledge claims.

To prepare graduates for competent practice in the world of work and to ensure a strong basis for practice students need disciplinary knowledge. Pure and applied

disciplines offer the resources of argumentation, the analytic and conceptual tools for professional understanding. To develop an understanding of the field of practice students need situated knowledge (Winberg et al 2011, 2013). Situated knowledge is both knowledge underlying work practices and contextual knowledge associated with the sites of practice. It is difficult to assess situated knowledge outside of its context of use (Shay and Steyn 2016). Situated knowledge is not generally valued as powerful knowledge in academic contexts but in professional practice it has extensive significance. Knowledge developed in practice is often tacit and is acquired in a more social way through participation in teamwork, through mentoring or coaching amongst others (Winberg et al 2013). Developing graduates who are knowledgeable and competent practitioners requires coherent curricular selection from the disciplines that underpin the profession and the situated knowledge that enables its practice (Winberg et al 2011, 2013).

Knowledge transformations – recontextualisations: how knowledge is put to work

Ashwin (2014, p126) argues that 'knowledge transforms our relations with the world, and [that] knowledge is transformed as we engage with it'. Ashwin refers in the first part of the dyad to the transformational relationships that academics and students develop with knowledge that defines higher learning; the second segment refers to how knowledge is transformed as it moves across different contexts. Transformation occurs as knowledge emerges from research, is selected and organised in curriculum, and as this knowledge becomes students' understanding (Ashwin 2014). All these transformations involve taking knowledge out of a particular context, and adapting it to suit a new context, and as such are referred to as recontextualisations, a term generated by Bernstein (2000).

Evans et al (2010) outline four rather than three forms of recontextualisation when disciplinary knowledge (theory) is integrated[69] into work-based knowledge and they explain knowledge as it is changed and transformed when 'put to work' across contexts of learning and practice. Firstly there is content recontextualisation which involves putting knowledge to work in programme design. Knowledge moves from its site of

[69] Integrating theory into work-based knowledge is often spoken of as a challenge of *transfer* from theory to practice; Evans et al (2010) consider the concept of transfer obsolete.

origin and production in the discipline into the learning programme or curriculum. Knowledge (content) is selected according to its purpose and should fit the needs of the professional and professional practice, and is simplified and recast into a teachable form. Disciplinary knowledge provides the logics for selection, recombination and the sequence in which it should be introduced to the student (Muller 2009, Wheelahan 2010, Winberg et al 2013). Secondly, there is pedagogic recontextualisation which is about putting knowledge to work in the teaching environment. Forms of knowledge are organised into learning activities and modules influenced by teacher assumptions of what constitutes good learning experiences, and also influenced by the requirements of professional bodies.

Workplace recontextualisation tests work problems with curriculum knowledge. Workplace environments fundamentally affect how knowledge is put to work by recontextualising concepts constantly and progressively in activity, and through mentorship, and a type of apprenticeship (Evans et al 2010, Winberg et al 2013). Finally, there is learner recontextualisation which is what learners make of the process and is critical to the development of a 'professional identity'. It happens through strategies the learner uses to bring together knowledge gained through the curriculum and knowledge gained from working with work-experienced people in the workplace (Evans et al 2010).

Table 3.1. Knowledge recontextualisations (adapted from Evans et al 2010)

Content recontextualisation	'putting knowledge to work' in programme design/ curriculum
pedagogic recontextualisation	'putting knowledge to work' in a teaching environment
Workplace recontextualisation	'putting knowledge to work' in a workplace environment
learner recontextualisation	what the learners make of the process.

The concept of recontextualisation identifies how knowledge changes as it is used differently in different social practices. Each of these transformations is the site of struggles (Bernstein 2000) where 'different voices impose different versions of legitimate knowledge' (Ashwin 2014, p124). There are always conflicts over the ways that disciplinary knowledge is transformed and positioned in curricula (Moore 2011, Muller 2011, Young 2013, Muller and Young 2014, Wheelahan 2010).

3.3.3 Mastery of new knowledge - epistemic ascent

Winch (2013) speaks of the journey from novice to expert as epistemic ascent[70]. An expert in a particular field will have learnt many concepts, will have mastered the ability to connect concepts by inferential relationship, and will know how to manage knowledge. Expertise thus reflects mastery of the different forms of KT and KH knowledge. Epistemic ascent is perhaps distinguished most by the ability to inferentially link concepts. This ability develops in stages, over time and is associated with the more mature student rather than the neophyte (Winch 2013).

The sciences can present particular accessibility challenges (Holtman and Marshall 2008, Young and Muller 2010, Winberg et al 2011, Muller 2015, Blackie 2014). Contributing reasons are likely to be that conceptual (propositional) and procedural knowledge are both typically highly systematic, with hierarchical arrangements of knowledge; and also that entry into the subject or discipline relies on mastery of inferential abilities. This makes it important for the lecturer to show the novice student how to access the tacit rules of the discipline and explicitly point out the relationships between concepts (Winch 2013, Holtman and Marshall 2008).

Disciplinary form imposes constraints on the appropriate form of curriculum (Maton 2009); and also imposes constraints on interdisciplinarity in curriculum (Muller 2009). The more vertical the knowledge the more that appropriate sequencing in curriculum matters, and the clearer must be the 'signposts' to the learners. Where later elements depend on the earlier elements first being grasped by students, otherwise described by Muller (2009, p216) as a 'hierarchy of conceptual difficulty', then the more critical is conceptual coherence of the curriculum. In other words, features of lesser or greater complexity need to be correctly sequenced in a coherent curriculum – it should ascend epistemically (Muller 2015). Alternatively, a curriculum can be segmentally connected where each segment is adequate or coherent to a context. Muller (2009) describes this form as contextual coherence within a curriculum and he emphasises that the more segmental the knowledge organisation, the less sequence matters in curriculum.

[70] Epistemic ascent can also be about the personal development of a student or learner into a particular kind of being or knower.

Effective curriculum design needs to factor in the hierarchies inherent in both procedural knowledge (KH) and propositional knowledge (KT) – in other words high level thinking is generated from knowledge of basic concepts or skills – and it also needs to allow for the maturation of the students' inferential abilities. This makes sequence and pace all important for optimising curriculum and the accessibility of teaching programmes especially in the concept-rich Science disciplines (Muller and Young 2014). A curriculum therefore should be designed to match the needs of the discipline or subject, as well as the needs and development of the student (Winch 2013). Muller (2015) advises that in planning curriculum we should continually be asking whether we are making it more difficult for students by arranging it a certain way, rather than another.

The acquisition of vertical discourse, or the building[71] of new knowledge, requires the development of the capacity to integrate meanings (Bernstein 2000). Students therefore need access to the system of meaning, which will differ according to the nature of the discipline (Freebody and Muspratt 2008). Epistemic access is a condition for social access, and epistemic access is mediated in different ways depending on how discourse is structured in curriculum and other knowledge practices (Wheelahan 2010).

3.3.4 Role of boundaries in acquiring new knowledge

As previously outlined, academic disciplines have their own particular disciplinary style of reasoning, their own relational and structuring organisation, and specific generative principles for making new knowledge. Disciplinary form is determined by the strength of the boundary and how the form develops and grows or advances conceptually. Specialised knowledge either builds cumulatively and progressively where new knowledge formulations (concepts) subsume earlier formulations (termed hierarchical by Bernstein 2000); or new knowledge can accrue by addition of parallel and segmented theories rather than by subsumptive means which Bernstein (1996, 2000) describes as horizontal. The formation of new knowledge is subject to discipline-specific truth warrants and judgements using criteria developed over time to test knowledge claims and some would say requires that the disciplinary domain be clearly demarcated with an

[71] *Building* knowledge is a term that I feel emphasises agency on the part of the learner; *acquisition* for me conveys a kind of passivity. I do however use both.

identifiable boundary (Young 2013). We also know that discipline or knowledge boundaries are not arbitrary; they sustain social relations (which have been the subject of various contestations about disciplinarity) and over time the socio-epistemic form becomes stable.

Muller (2009) maintains that the different knowledge structures need to be differentiated in curriculum and in pedagogic practice. It is critically important to structure knowledge in curriculum so that it is accessible to students and so that the student can navigate between different types of knowledge and use it appropriately (Muller 2009, 2014, Wheelahan 2007, 2010, Young 2010). Because values, norms, practices, and what counts as legitimate knowledge reside within particular sets of boundaries, curriculum must be premised on helping students to acquire the capacity to recognise the boundaries between different kinds of knowledge(s) as a condition of equitable access (Muller 2014).

Young (2010, p15) argues the importance of maintaining boundaries, prior to 'boundary crossing (as) a necessary condition for the creation and acquisition of new knowledge'. Access and understanding is about first recognising what the boundaries contain or demarcate before transcending their limits, and unless students have access to generative principles of knowledge they are not able to go beyond or transcend the particular context (Wheelahan 2007). The argument is not for rigid enforcement of boundaries, instead that one needs to understand where the boundaries are and how they distinguish between knowledges in order to do the very important work of boundary crossing. Students who learn isolated facts which are dislocated from the disciplinary domain need to acquire the capacity to integrate knowledge (and underpinning principles) through the 'system of meaning' bounded by the discipline and if students are denied access to disciplinary ways of reasoning, and the generative principles of the discipline, then those students are effectively locked out of powerful knowledge (Wheelahan 2007).

Wheelahan understands interdisciplinary work to be about explicitly negotiating disciplinary boundaries; that there are those who argue interdisciplinarity requires of teachers and students a grasp of disciplinary knowledge perhaps even more than

disciplinary teaching and learning, yet frequently it is interdisciplinary sorts of programmes that tend to be offered to academically weaker students. Wheelahan (2007) talks about vocational students being locked out of access to powerful knowledge when they do not have access to the core of a discipline and its structural framework. This can happen in interdisciplinary programmes or those moulded on genericism.

3.4 Curriculum

Curricula are always associated with power and control which preside in how, and by whom, curricular decisions are made - curriculum manifests the complex interweaving of political and curricular ideologies, linked to political and economic changes (Young 2014).

Though there are many differing understandings of curriculum, in this thesis I use curriculum as a concept that refers to the knowledge it is hoped that students will acquire by the end of the course, while pedagogy refers to activities of teachers to enable students to acquire knowledge specified by curriculum (Young 2014). Knowledge always originates in a particular context. Curriculum represents knowledge which has been selected from the field where it was originally produced (usually the disciplinary domain at university) and recontextualised into pedagogic discourse. This recontextualised knowledge (as a subject or module) is open to different levels of control insofar as sequencing and pacing of content (Young and Muller 2010, Muller 2014).

Knowledge development in a hierarchical structure involves the integration of antecedent, previous knowledge into new knowledge. This is a cumulative process. Cumulative learning enables the learner to recontextualise knowledge, to transfer that which has been learned across contexts such as further studies or the workplace. The learning process thus involves decontextualisation (abstraction) and recontextualisation (new context). In a horizontal structure, knowledge is strongly bounded and develops by addition or aggregation of segments. This is a segmental process. Segmented learning occurs when knowledge is locked into pedagogic contexts, problematising students' ability to integrate meanings and transfer understanding across contexts, including their ability to apply meaning to new contexts such as later studies, everyday life and future

work (Maton 2012, 2013, Wheelahan 2010, Young and Muller 2014). Some forms of knowledge may be more capable of cumulative knowledge building than others, while other knowledge forms are more suited to the learning needs of certain social groups than others (Howard and Maton 2011).

Consequently we can also describe curriculum structures as being either cumulatively organised where, for example, modules or units of study coherently and explicitly build on previously learned modules; or segmental where units of study are strongly bounded and form loose aggregations with little if any continuity between what has been learned previously. A segmental non-sequentially organised syllabus (curriculum) promotes segmented teaching and segmental learning; conversely a coherent cumulatively organised curriculum is likely to enable cumulative knowledge building by students. My project explores whether cumulative learning is enabled or not by the manner in which curriculum is structured.

Young (2014, p8) speaks of curriculum being a structure offering 'constraints and possibilities'. The purpose of curriculum is to provide students with access to powerful, and the possibility of acquiring context-independent, abstracted knowledge, which enables the thinking of the not-yet-thought. The constraints, Young argues, come through boundaries between subjects, and between educational knowledge and everyday knowledge and possibilities in terms of boundaries arise where these can guide what it is that students can learn, and also demarcate their progression through learning.

In scientific fields especially, there has been exponential growth of new knowledge over the past few decades, posing challenges to its curricularisation (Muller 2009, 2015). Alongside the knowledge explosion there has been widening of access to universities globally resulting in big increases in the number of students and the question remains how curricula may have developed in tandem. Particularly in Anglophone countries, according to Wheelahan (2010), there was a trend in curriculum towards emphasis on personal attributes or competence, generic skills to be employable, and (market) relevance and trainability (Beck and Young 2005). In South Africa, knowledge also tended to be included in curriculum through its criterion of relevance with less emphasis

on specialised knowledge (Ensor 1998, 2004). Knowledge was regarded instrumentally hence the movement became known as vocationalism or instrumentalism (Wheelahan 2010).

3.4.1 Curriculum debates and developments

Curriculum is a complex, politicised issue and different curricular theories are often hotly contested. I outline two models that arose as a counter to the traditional neoconservative movement, and embed these in the circumstantial drivers of the times - be these sociological, economic and market-related factors or other. Framing the progressive debate on the one hand was a trend towards constructivist pedagogy, giving developmental discourses of experiential, student-centred and situated learning which appropriated the contextualised nature of knowledge, and where formative assessments tended to become favoured over summative. The intricacies of curricular shifts are complex and there are both merits and detractions. Generic modes of curriculum tended to emphasise integration and there were trends to move away from disciplinary knowledge modes towards more interdisciplinary modes of teaching and learning.

Moore and Young (2001) provide an account of the curriculum debates which took place in the UK at the start of the millennium in response to the aforementioned pressures. An understanding of the curriculum ideology, socio-educational trends and contestations about the purpose of knowledge, provide context from whence the curriculum of my study may have emerged. Further changes in the Faculty of Health Sciences included a shift in MBChB pedagogy from a traditional, hierarchical model to a facilitative approach (student-generated learning) and a modularised case-based or problem-based (PBL) curriculum within which were embedded several generic skills modules such as 'quantitative literacy', 'critical reasoning', 'becoming a doctor' and 'becoming a health professional', the latter shared with physiotherapy and occupational therapy students.

Traditional model (neoconservatism) versus Technical/Instrumentalist model (vocationalism)

Influenced by economic factors and in order to better prepare students for employment, the Qualifications and Curriculum Authority of 1999 (United Kingdom) encouraged all university students to mix vocational and academic subjects; all university subjects to

incorporate key skills, and to show students how to apply knowledge; subject specialists to show how their subject linked with others, and to facilitate teamwork and communication (Moore and Young 2001).

In the UK, there was fervent debate, which is still ongoing, between those supporting a traditional model of curriculum and the technical-instrumentalists who supported vocationalism or training for the job market (Moore and Young 2001). The traditional model was seen by some as inefficient and out of touch with a competitive global society, and deemed too elitist (Muller 2015). For these reasons, some universities responded to pressure to move away from disciplines, to rather more inter- or transdisciplinary modes of knowledge production. At the same time (also in schools curricula) there was a shift in the curriculum from subjects to modules, mixing of vocational studies and academic studies, and introduction of generic skills. The traditional model assumed that knowledge is best produced and transmitted in insulated, specialist, linear, hierarchical mode. The primary short-coming of this model is that there is sole focus on knowledge and there is not a focus on the social context of knowledge. Thus it maintains elitism without addressing inequality of access (Moore and Young 2001, Muller 2015).

The technical-instrumentalist model supports a connective approach to knowledge production (transdisciplinarity) and in favouring generic skills, modularisation of curriculum, integration of knowledges (a type of underspecialisation) and facilitative approach to pedagogy, seems to overplay the social context at the expense of a focus on knowledge. (Table 3.2. summarises strengths and weaknesses of the different curricular models)

Table 3.2. Different modes of knowledge production and curriculum arising from the Qualifications and Curriculum Authority report of 1999 in the UK (adapted from Moore and Young 2001):

Traditional (neo-conservatism)	Technical-instrumentalist (vocationalism)
Favoured the insularity of disciplines as sites of knowledge production	Favoured a transdisciplinary approach to knowledge production. Connectivity between knowledge and practical application.
Specialisation of knowledge in linear, coherent curriculum	Modularity of curriculum Emphasis on generic skills
Hierarchical pedagogy (teacher-centred)	Facilitative approach to pedagogy (student-centred)
Separation of general and vocational knowledges	Integration of general and applied knowledges

Curriculum debate renewed: Traditional versus progressive/modern

From the outset Moore and Young indicated the potential shortcomings of approaches based only on knowledge or based mainly on skills. Already at that time there was the need to consider an alternative model. More than a decade later the argument is still being taken forward by Young and Muller (2010) and Muller (2015).

Muller (2015) addressed the position of knowledge and skills in curricula specific to Science and Engineering. He foregrounded two key points as crucial to curriculum considerations in scientific fields: firstly he re-emphasises the massive increase in knowledge production (and technological advances) in most Science fields since 1950s. The increased specialisation of knowledge raises the cognitive demand of each level of education and the ever-increasing addition of new knowledge potentially leads to overloaded curricula. The tendency then is to step up the pacing[72] in delivery of curriculum. This approach, according to Muller (2015) favours students from more privileged backgrounds, who have been educated in cognitively-rich environments by better qualified teachers, and it further disadvantages the already disadvantaged student. Secondly, each discipline or its curricular subject has different epistemic and social properties and this means different logics for coherence and sequencing in curriculum planning and management. In South Africa's higher education scenario we

[72] Muller (2015) refers to speeding up and compressing the curriculum as a response to an increased volume of novel material.

need to direct attention on what is conferring disadvantage and what is hindering epistemological access.

Table 3.3. Bringing the curriculum debate into current view. Young and Muller (2010) and Muller (2015) contrast the Traditional with Progressive curricular model, noting that there are positive features of each:

Curriculum model based on Traditionalism	Curriculum model based on Progressivism / constructivism [activity or practice orientation]
The focus is on content with knowledge as facts and concepts. This model had its origin in teaching the elite. With massification of higher education and diversification of the sociological base, and with burgeoning new knowledge production in the Sciences, this model has shortcomings. Science and Engineering still generally follow a traditional curriculum (Muller 2013, 2015).	The focus is on activity / action and not on the knowledge base on which successful action depends. It foregrounds the teacher and the student, and in so doing loses a focus on differentiatedness of knowledge. Constructivism aims to develop the intrinsic capacity of the student, and exposes the student to situations where s/he can construct view of the world. Constructivism gained popularity perhaps because of the dynamism involved in constructing new knowledge (Muller2015). Because the model does not accept the hierarchies in education as fixed, it gained momentum alongside the democratic movement.
Undersocialisation and knowledge focus.	Oversocialisation and diminished focus on knowledge.

The tension between undersocialisation and oversocialisation of curriculum thus affects the emphasis on knowledge. It is for this reason that a different model using a social realist approach to education has been proposed by Moore, Young and Muller on an ongoing basis (2001, 2010, 2015). The progressive approach to curriculum has its merits. However Muller (2015) cautions that there is a diminished focus on knowledge when emphasis is placed on experience rather than knowledge specialisation and on skills rather than propositional knowledge. He cautions further against emphasising learner differences rather than knowledge differences, and emphasises that specific knowledge types have specific pedagogic requirements.

Constructivism and instrumentalism have similar constraints in that both emphasise the contextual, situated (or authentic) and problem-oriented nature of learning.

Consequently, neither complexity nor the structuring of contexts is visible and the distinction between producing, acquiring, and applying knowledge is collapsed (Wheelahan 2010). Knowledge is central to curriculum regardless of whether its purpose is to prepare students for academic disciplines or to prepare them for occupational fields of practice, although the orientation and focus of knowledge in curriculum will differ in each case. Wheelahan (2010) concludes with two salient points; firstly that there is no opportunity to consider providing students with access to powerful knowledge if knowledge is displaced in curriculum and replaced by 'relevant and 'practical' knowledge; and secondly that unless curriculum is organised so that working class students (low SES) and others who are excluded, have equitable access to knowledge they will always be on the outside looking in, largely excluded from society's conversation about what it should be like.

3.4.2 Professional curricula

Winberg et al (2011, 2013) argue that students in professionally-oriented programmes need epistemological access to both disciplinary and situated knowledge. They need to identify themselves as university students engaged in complex processes of disciplinary learning, and secondly as professionals in training they need to be adequately prepared to engage with and contribute to the world of work. Educating graduates who will be worthy representatives of their professional group and of the service that they are responsible to provide, necessitates protecting underpinning disciplinary knowledge of the profession from short-term, utilitarian and instrumental ideas of education geared only to minimal preparation of practitioners for an assumed site of practice.

There are complex relations between professional practice, the professional regulating body, and university-based teaching and assessment of professional knowledge. The demands of the practice and the relevant professional body set the guiding requirements of what needs to be selected from disciplinary knowledge and relocated into curriculum - the academy cannot simply determine what to include in curriculum. The traditional professions, such as Medicine, were once characterised as having considerable autonomy over certification of professional competence, conditions of professional training and scope of practice; with professional bodies ensuring ethics and accountability of practitioners. Traditionally these mechanisms served as insulation and

strong external boundaries around the corpus of professional knowledge (Beck and Young 2005).

Professional knowledge and the university-based disciplines to which they relate brings forward the concept of professional curriculum orientated to the world of practice. The term for this is 'regionalisation' according to Bernstein (2000) who normally categorises the knowledge structures that underpin professional knowledge not as singulars but as regions[73]. Independent disciplines (singulars) may cluster to form a new region of knowledge, but more usually regions are orientated to support a domain of professional practice (Muller 2009). In the process, disciplines may or may not retain their specialised distinctiveness (Muller 2009). Engineering, Architecture and Medicine constitute regions according to Bernstein's definition (2000). Physiotherapy and occupational therapy draw on multiple disciplines and face the world of work and I would argue can also be considered regions.

Changes in health care necessitated changes in medical education. Alongside, the pattern of disease has shifted, and what society expects of its doctors has altered. Healthcare has shifted from the individual to the community, from cure to preservation of health, from episodic care to comprehensive care, and from a single physician approach to community-based care by primary health care teams. Concomitantly, the emphasis changed over the past two decades in several West European countries, and in parts of Australia and the USA, from passive acquisition of knowledge to active learning and from mostly teacher-centred to more student-oriented learning; problem solving is important and the integration of several disciplines in dealing with health problems is acknowledged. Rigid educational programmes have given way to more flexible methods of curriculum delivery; in many European countries as well as Canada, Australia and the UK, traditional and integrated curricula are still being taught at the same time (Jones et al 2001). The WHO / Lancet review revealed that there is 'still uncertainty about the ability of integrated, problem-based curricula to deliver improvements in the knowledge base and in clinical ability' (Jones et al 2001, p700).

[73] Regions are structures where disciplines blur and do not have clear boundaries; and where professional knowledge draws on multiple disciplinary bases (Bernstein 2000)

Starting in 1990 many medical schools in the USA (and in other countries) implemented student-centred, problem-based curricula and the debates about the merits of PBL for medical education continue to this day. Glew (2003) regarded himself as a 'true believer' in the principles of PBL medical education, but a decade later is disappointed in the implementation of PBL curricula and the trend towards being 'science-light'. He found that senior students, during clinical rotations demonstrated 'shallow knowledge of the basic biology that underlies the illnesses of patients' and that these students had 'poorly developed ability to reason their way through a problem from basic principles' (Glew 2003, p53). In a South African context, PBL medical curriculum was adopted in 2001 at UKZN and a study by Tufts and Higgins-Opitz (2009) revealed that the PBL approach has resulted in significant gaps in students' understanding of basic physiological concepts and that this also impacted their understanding of pathology, and their interpretation of patients' clinical signs and symptoms.

Muller (2009) raised similar concerns about knowledge gaps resulting from a PBL curriculum. An emphasis on a contextual problem to be solved rather than disciplinary knowledge to be learned flouts sequential requirements of the vertical parent knowledge structure and there are limits to segmentalising (or contextualising) the curriculum of a vertical discipline if perverse effects are to be avoided (Muller 2009, Wheelahan 2010). It is critical for curriculum design that the more vertical the discipline the more important is necessary coverage, appropriate pacing and especially sequence. If congruence is scrambled by modularisations or PBL stipulations that renders conceptual sequence invisible then learning is put at risk: then either 'crucial conceptual steps are missed and learning stops, or there are chunks of knowledge missing – knowledge gaps' (Muller 2009, p219).

In this chapter the socio-epistemic basis of knowledge, the intricate linkages between different forms of propositional and procedural knowledges and the necessity to include all in good curriculum design, the imperative for appropriate sequencing to support cumulative knowledge building, and the enablements of epistemological access, have all been explained as a constellation of intimately linked concepts.

CHAPTER 4. THEORETICAL FRAMEWORK

Theorising the nature of knowledge is key to the sociology of education because it provides an understanding of the way knowledge structures the curriculum, and how it should be taught and evaluated in classroom practice so that there is equitable access to it – the structure of 'pedagogic discourse and the rules that regulate how knowledge is distributed, recontextualised and evaluated are all mechanisms for relaying power relations in society in ways that exclude and include' (Wheelahan 2010, p18). For my own study purposes, where wide disparities in performance in all likelihood reflect differential access to knowledge, I am motivated to find out what it is about knowledge practices (specifically in the curriculum) and their organising principles that might explain differential access. In other words, what it is that might effectively exclude some while including others. A social justice agenda underpins my research project and so I explore which organising principles of educational practices might lead to unequal outcomes, enablement of certain students and marginalisation of others. We need to understand how different kinds of knowledge can be made more accessible to the majority of students.

This chapter begins with a broad overview of the study's underpinning ontology, realism and then expands on the social realist approach which frames this study. Next I outline Basil Bernstein's code theories (1977-2000) which foreground knowledge and formulate a theorisation of educational practice. Legitimation Code Theory (LCT) is a powerful explanatory and analytical framework developed by social realist Karl Maton (2000 – 2016) which considerably extends Bernstein's theory, allowing analysis of the organising principles (languages of legitimation) of knowledge practices and contexts. I provide an indication of how I have used LCT in this study to provide greater explanatory power to my research problem.

4.1 Realist approach

This study is positioned in a realist approach to understanding knowledge practices as socially constructed and as real. To understand what the concept of 'real' conveys, I outline briefly some key points of the critical realist philosophy from which social realism emerged.

4.1.1 Realism at a glance

The essential understanding of Realism is that reality exists beyond human conception of it - there is a level of reality beyond what we know or what we can observe. The world is understood to be stratified into three different domains of reality: the Empirical level is subjective and represents our experience and perceptions of events; the Actual level is the domain of events or phenomena; the Real level is a deep dimension, existing independent of our knowing, where one finds the generative mechanisms which produce the events in the world (Danermark et al 2002). Phenomena (events) are the manifestation of compound effects of different mechanisms and powers which are concurrently active in the deep, stratified, dimension of reality. Within the stratified Real domain, when the qualities of underlying mechanisms are combined then new objects come into existence (emerge). Mechanisms are thus said to have emergent or generative powers (Danermark et al 2002).

Our experiences, perceptions and interpretations of reality (at the Empirical level) are subject to change and fluctuations dependent on social conditions, as are the phenomena (at the Actual level), while the underpinning mechanisms or principles (at the level of the Real) are relatively stable and durable. In seeking to move beyond assumptions about why and how the world is as it is, realist social research goes beyond the observable so as to uncover powers and generative mechanisms beneath any event. Connecting the empirical, the actual and the real is to identify the effect of underlying mechanisms. If we are to understand the dynamic dimension of reality, then there needs to be analysis of the causal conditions, and because there is simultaneous occurrence of, and interplay between several variables, a direct link between cause and effect is hard to anticipate (Danermark et al 2002). Causal analysis is the process of explanation of what generates or enables the event coming about. This is central to a critical realist framing of research. For this study, the phenomena under scrutiny in the realm of the actual are curriculum and other knowledge practices, all of which are underpinned by powers, values and principles in the realm of the real. It is these organising principles that I wish to elucidate so as to explain some of the ways in which curriculum and other educational practices may work to include or exclude students' epistemological access.

4.1.2 Social Realist sociology of education - knowledge as real and socially constructed

Social realism is an approach in the sociology of education – a broad school of thought (Maton 2011, 2014) or a 'coalition of minds' (Maton and Moore 2010, p10) which forms a link between sociology and realist philosophy. Social realists want to understand the social basis of knowledge and the nature of knowledge itself. Many credit the influence of the sociology of Basil Bernstein for bringing knowledge into view (Maton 2009, 2010, 2014, Moore 2010, Muller 2007, Wheelahan 2007, 2010, Young and Muller 2010, 2013). Social realism is about exploring the social grounds for objectivity in knowledge and realism reminds us that knowledge is about an objective world which exists independent of our knowing about it.

Social realism puts knowledge foremost in thinking about education, and shows that knowledge is socially constructed by communities of knowledge producers, and is dynamic, meaning that socially produced knowledges change over time and across socio-cultural contexts (Maton 2009). Knowledge is socially produced but at the same time has the capacity to transcend the social conditions under which it was produced (Maton 2000). Social Realism is underpinned by theories of society and knowledge, and knowledge is understood to be a means by which social purpose is realised (Wheelahan 2010). While knowledge might be socially constructed and open to change, social realists view knowledge as real in that it possesses properties, powers and tendencies that have effects (Maton 2009, 2014). Knowledge involves both social power and epistemic power (Maton and Moore 2010, Maton 2010), and is the focus of 'ongoing struggles among historically and socially located actors with different resources' (Howard and Maton 2011, p195). Knowledge is about something other than itself - an independent reality exists that helps to shape our knowledge of the world (Maton 2010, 2014).

Knowledge has emergent properties that transcend and 'react back' on social contexts and practices. In this way, knowledge practices are emergent from but irreducible to their contexts of production, recontextualisation, teaching and learning (Maton and Moore 2010, Maton 2014). Knowledge is thus viewed as being fallible, always developing, and revisable in the light of new evidence (Young & Muller 2007). Knowledge is real, differentiated and possesses emergent structural qualities and

therefore curriculum and pedagogy should be structured[74] to take into account these qualities. Some forms of knowledge are more powerful than others which imply a hierarchy. Curriculum and pedagogy need to be structured to take account of such hierarchies (Maton and Moore 2010). The different structurings of knowledges provide 'different affordances' and lend themselves to different forms of pedagogy and evaluation (Maton 2010, p55). The social realist movement proposes that the principal purpose of education is to provide students with access to and acquisition of knowledge (Young's foreword in Wheelahan 2010). The means that most reliably enable access to the most powerful forms of knowledge are likely to vary according to the social backgrounds brought into education (Maton and Moore 2010).

4.2 Developing Analytical frameworks

Basil Bernstein started his theorising in the field of socio-linguistics and thereafter developed his interest in creating theoretical frameworks about the sociology of knowledge. Bernstein is recognised as a pioneer in conceptualising organisational or structuring codes for knowledge – code theory - and in always relating knowledge to the socio-cultural realm. Several landmark concepts in Bernstein's theorisation proved fertile evolutionary nodes from whence Maton expanded an explicit explanatory and analytical framework (Legitimation Code Theory) and for this reason I focus on pedagogic codes, the pedagogic device, and knowledge structures.

4.2.1 Bernstein's theorisation of knowledge and education: concepts and codes

Pedagogic codes: Classification and Framing

Bernstein (1990) formulated the codes of Classification (C) and Framing (F) as a means of explaining and analysing the structuring and organising principles of educational practices. In so doing, he distinguished power as operating on interactions and relations between categories to legitimise boundaries, while control operates within a category to establish legitimate forms of communication (Bernstein 1996). Categories can be discourses, practices or agents.

Classification refers to the locus of power: it refers to the strength of insulation and boundary between one category (of discourses, practices or such like) and another. A

[74] For example through the sequencing of knowledge in curriculum (Young and Muller 2007).

strong boundary maintains the 'identity – the distinctive voice -and specialisation' (Bernstein 1996, p20) of the category. If the insulation is broken, then a category can be in danger of losing its identity however boundaries do shift to constantly adopt new discourses, pedagogic practices or agents (Bernstein 1996).

Framing refers to the locus of control: it refers to regulation of relations within a context such as communications in pedagogic practice. Framing is concerned with 'how meanings are put together' and with 'who controls what' (Bernstein 1996, p27). In describing strong framing, Bernstein explains that where there is strong control of the internal logic of pedagogic practice, then the 'transmitter' has 'control over the social base which makes the transmission possible' and has strong control over selection, sequence, pacing[75] (Bernstein 1996, p28).

Bernstein considered codes to be the underlying principles shaping pedagogy, curriculum and assessment. He used two forms of codes to describe two extremes of curricular structures at schools. The most usual is a strongly classified and framed Collection Code (+C+F) meaning there is emphasis on educational knowledge and identity, while the other, an Integrated Code (-C-F) is weakly classified and framed indicating weakened knowledge and identity. The notion of codes thus refers to strengths of boundaries (C) and strengths of control (F). For Bernstein, classification (C) and framing (F) codes were represented on a binary scale as either strong (+) or weak (-) forms, leading to ±C/F.

The Pedagogic Device (PD): fields, rules and the arena

For a comprehensive understanding of educational practice, Bernstein (1996) developed a tool called the pedagogic device which is the mechanism by means of which the relationship between the realms of knowledge production, recontextualisation of knowledge into the educational curriculum and meaning acquisition (learning) can be represented. The device is descriptive of a process whereby knowledge is transformed from its field of production into pedagogic discourse subject to distributive, recontextualising and evaluative rules. These rules are 'not ideologically free' and thus

[75] Bernstein also points out that framing can vary across the various elements.

the pedagogic device becomes a 'site for appropriation, conflict and control' (Bernstein 1996, p42). The pedagogic device shows how one can dig deeper to explore the mechanism generating the organising principles (Maton 2016).

Distributive rules operate in the field of production and distinguish which knowledges are worthwhile within the specific disciplinary context and which knowledge should be disseminated to whom. Embedded in this description is the notion of access, so by Bernstein's definition distributive rules regulate access to knowledge. Recontextualising rules are principles for constructing pedagogic discourse which translates the knowledge from the field of production into the knowledge of the curriculum by 'delocating a discourse, relocating, refocusing' it (Bernstein 1996, p47). Those agents responsible for the recontextualising process practice their own ideologies in selecting the what and how of pedagogic discourse. Inherent in this ideology is a 'model of the learner, and of the teacher, and of the[ir] relation' (Bernstein 1996, p49). Recontextualising principles mediate the way knowledge is classified and framed by competing perspectives about the purpose of education (Wheelahan 2010). Knowledge has thus shifted from the field of production, where it is created, to the field of recontextualisation, where it is translated into the planned curriculum structures. It undergoes a further shift into the field of reproduction, where it is taught and learnt.

In the field of reproduction, evaluative rules stipulate the 'specialised consciousness that should be acquired' (Bernstein 1996, p43). In effect, evaluative rules define the standards which students should meet. In order to achieve this objective, students need to understand the recognition and realisation rules. Recognition and realisation operates at the level of the acquirer. It is the student who needs to recognise the achievement requirements and the type of knowledge s/he is dealing with and this is not only about 'identifying and understanding specialised knowledge but also of understanding knowledge as contextualised within its disciplinary system of meaning, and decoding it' (Wheelahan 2010, p34). There may also be recognition without realisation: a student may be able to recognise the form of knowledge but may not understand the implicit rules of assessment (Wheelahan 2010).

The pedagogic device creates an 'arena of struggle for those who wish to appropriate it ... whoever appropriates the device has the power to regulate consciousness' (Bernstein 1996, p52). If the arena is a higher education context, then it is usually the academic[76] who in response to certain principles and ideologies selects the knowledge to be taught (and in so doing chooses what is legitimated or privileged); oversees the sequencing of content knowledge and pace of instruction (instructional discourse); and determines what performance is valued (standards of achievement). The academic therefore determines what counts as valid knowledge both to be taught and for the taught (Shay 2011). This demonstrates how the arena can be considered a space for contestations over power, control, ideologies and legitimacy in the field of knowledge. In the context of this study such considerations are brought to the exploration of what underpins the Human Biology course within the specific study context.

Table 4.1. The arena of the Pedagogic Device (adapted from Maton and Muller, 2007)

Field of practice	Field of Production	Field of Recontextualisation	Field of Reproduction
Form of regulation	distributive rules	recontextualising rules	evaluative rules
Symbolic structure	knowledge structure	curriculum	pedagogy and evaluation
Principal types	hierarchical and horizontal knowledge structures	collection & integrated curricular codes	visible & invisible pedagogies
Typical sites	laboratories, research papers, conferences	curriculum policy, textbooks, learning aids	classrooms, examinations

Development of the Epistemic-Pedagogic Device (EPD)

Karl Maton (2013) reminds us that Bernstein always urged expansion of his ideas and supplied the blueprint to the development of the Epistemic-Pedagogic Device (EPD) and to Legitimation Code Theory (LCT) which is discussed later. As is evident in the name, the Epistemic-Pedagogic Device (EPD) builds upon and integrates Bernstein's pedagogic device (PD). As with its predecessor, the EPD has three fields each with its own structure and logic and the arena remains a site of contestation and struggle for legitimacy and

[76] In some instances the curriculum is prescribed and the academic simply implements.

domination. While the EPD as much as the PD is not empirically operational, it allows one to conceive of all fields of educational practice and the relations between these fields. It allows one to visualise what is happening to knowledge as it transformed across domains and allows a perspective of where power struggles can occur and which actors are at play. Organising and structuring logics are not empirically demonstrable, instead they are known by their effects. Organising principles (bases of legitimation) can however be analysed by legitimation codes. The arena shapes the position and practices of intellectuals, recontextualisers, teachers and students (Maton 2013).

Maton developed the EPD in several ways: The term logic replaces rules, which is deemed too deterministic. The EPD has four logics as compared to the three rules of the PD; firstly epistemic[77] logic regulates the field of production; secondly recontextualisation logic regulates the field of recontextualisation by rearranging knowledge to become pedagogic discourse; and thirdly evaluative logic is what regulates pedagogic practice (teaching and learning). Recontextualisation (delocation and relocation of discourses) can happen in each field and not only in the field of recontextualisation. This means that educational knowledge and the recontextualisation thereof flows in both directions (though not equally). Distributive logic effectively regulates access to each and all three fields, thus the entire arena and in this way distributive logic determines who enjoys access to what. As Bernstein originated, whoever controls the EPD has the power to influence entire fields of practice – and to 'set the field in their favour' Maton (2013, p72). Knowledge structures exist across all three fields of the EPD (as shown in Figure 4.1.).

[77] This replaces the term 'distributive rule' which Bernstein determined as 'granting access to'. Historically Bernstein afforded this field more of a pedagogic slant, and by its renaming, Maton foregrounds epistemological concerns in the field of production.

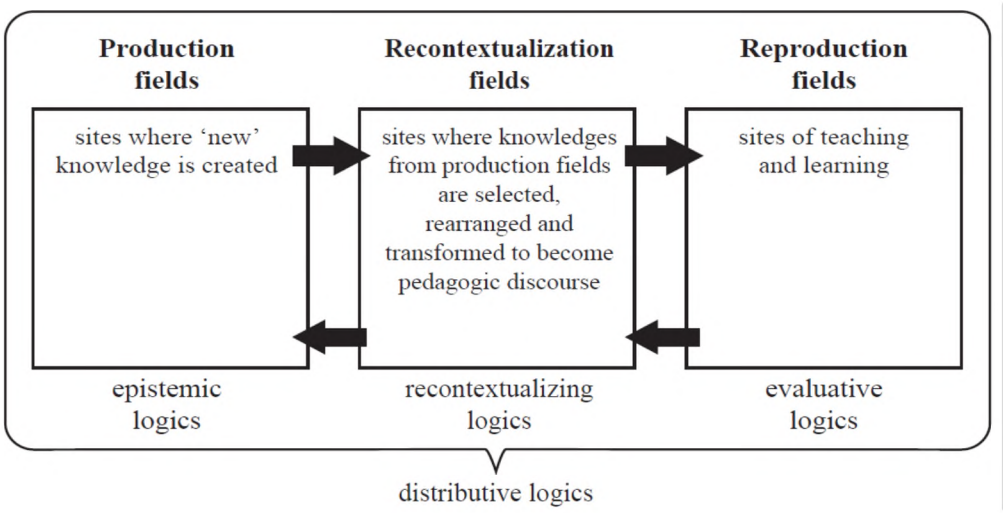

Figure 4.1. Arena created by the EPD (from Maton 2013, p52)

Structures of knowledge

Bernstein's latter work (in 2000) included theories of discourses (grammars) and knowledge structures. He distinguished between horizontal discourse (commonsense or everyday knowledge) and vertical discourse (scholarly, conceptual, abstract or professional knowledge). He further specified that vertical discourse can be either hierarchically organised taking on a 'coherent, explicit and systematically principled' form or it may take on a segmental, horizontal form reflecting a 'series of specialised languages with specialised modes of interrogation' (Bernstein 1996, p171). Within the vertical discourse of academy, there can thus be seen to be different structures of knowledge.

In differentiating the knowledge structures, Bernstein (1996, 2000) explained that within hierarchical structures new knowledge develops by integration and subsumption of prior knowledge, and the grammar is strong, explicit and coherent; whereas horizontal structures reflect a segmented organisation where new knowledge is built by accumulation and aggregation and where articulations can be precise and explicit grammars strong, or articulations and grammars can both be weak.

Table 4.2. Differentiation between hierarchical and horizontal knowledge structures and discourses

Hierarchical knowledge structure	Horizontal knowledge structure
'a coherent, explicit, systematically principled and hierarchical organisation of knowledge' which develops through 'integrating knowledge at lower levels, and across an expanding range of phenomena' (Bernstein 1996, p173). This knowledge structure is typically represented thus: 	'a series of specialised languages, each with its own specialised modes of interrogation' ... a segmented organisation where new knowledge is built by accumulation and aggregation (Bernstein 1996, p173). This knowledge structure is typically represented thus: **L1 L2 L3 L4 L5**

Many social realists (such as Maton, Muller, Wheelahan, Young) understand that students need to comprehend more basic principles before moving on to more complex ones and thus that students need to be inducted into vertical discourse and the relevant systems of meaning of hierarchical or horizontal knowledge structures.

4.2.2 Knowledge-Knower structures – Maton's expansion of Bernstein

Just as there are hierarchical and horizontal structures of knowledge, so these forms exist within knowers. Every knowledge structure has a knower structure so in its totality then it becomes a knowledge-knower structure (Maton 2008 - 2014). A hierarchical knower structure takes the form of an idealised knower at the pinnacle; the structure grows by integrating new knowers from lower levels across expanding arrays of dispositions - this hierarchy of knowers is typical of the humanities. Horizontal knower structures demonstrate segmental series of non-connected knowers each with their own specialised ways of being, which is more typical of the sciences. There is always a hierarchy somewhere and one needs to find out where it resides (Maton 2013). Conceptualising practices as knowledge-knower structures gives a more comprehensive picture of these practices.

Knowers have a gaze which embodies a way of knowing - a gaze is a way of recognising what is legitimate knowledge. This knower-based attribute can be viewed as born (natural talent); cultivated, trained or socially positioned (based on for example, race,

gender, age or class). Of these gazes within the knower structure, the cultivated gaze is appropriated after being immersed in a field, while a trained gaze depicts a way of specialised knowing that is fostered in a master-apprentice training relation. These two gazes have particular relevance to training of the professional groups which are the focus of my study.

4.2.3 Legitimation Code Theory (LCT) – advancing code theory

Legitimation theory, concepts and codes explained

The notion of legitimation offers a social realist approach which highlights both the sociological nature of knowledge and its epistemological nature (Maton 2010). LCT enables knowledge practices 'to be seen, their organising principles to be conceptualised and their effects to be explored' (Maton 2014, p3). Legitimation code theory is a practical and explanatory theory which uses an array of concepts to provide explanations to substantive problems (Howard and Maton 2011, Maton 2014, 2016). It is a sophisticated conceptual toolkit and analytic methodology that allows the researcher to explore the organising principles of several modalities underlying practices, dispositions and contexts (Maton 2000 - 2016).

Maton acknowledges that LCT integrates aspects of Bourdieu's field theory nonetheless it is more directly and prominently founded on the principles of Bernstein's code theory. LCT offers a range of dimensions, also known as tools or principles, which are all built on the conceptual foundations of classification and framing. Maton (2013) points to Bernstein's theorisation as being pivotal and key to foregrounding knowledge. However, while placing knowledge at the epicentre and positing relations to knowledge, and relations within knowledge, Maton has more explicitly defined the afore-mentioned relations as well as the capacity to analyse the organising principles (legitimation codes) that underpin knowledge practices. LCT has its foundation in Bernstein's code theory but extends it in several ways: LCT embraces more phenomena, and all practices are construed as languages of legitimation or claims to legitimacy whose organising principles are conceptualised as legitimation codes. So LCT is concerned with questions about how such legitimation occurs and how it is enforced, and also how certain forms of knowledge or certain kinds of knowers are deemed not legitimate. Secondly LCT reconceives of codes in terms of topology as well as typology. Bernstein's code typology

has generally been seen to be dichotomous, and so something has strong Classification or weak Classification, strong Framing or weak Framing but LCT can be expressed by any number of points along a continuum. This allows for the mapping of various concepts along axes of whatever particular concept is being analysed. Related code concepts can then intersect to form the axes of a Cartesian plane, where the strengths of elements are relationally stronger or weaker. Cartesian planes map out a topology of 'infinite possibilities of possible positions' (Maton 2016, p10) – see schematic representation below.

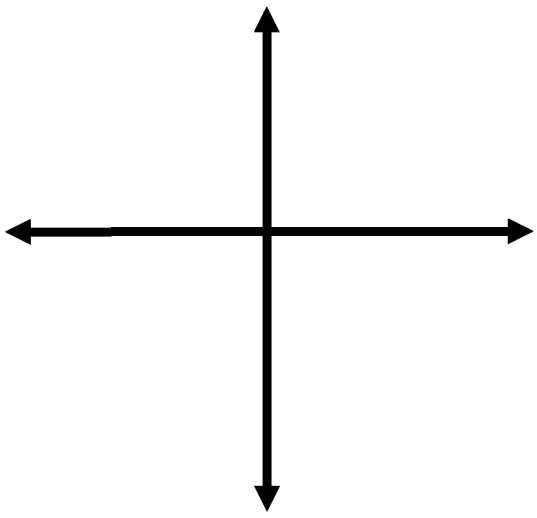

Figure 4.2. Cartesian planes represent a topology of infinite possibilities

Furthermore LCT extends Bernstein's pedagogic device to become a multidimensional legitimation device where each dimension comprises concepts referring to organising principles underlying practices, contexts, dispositions. Although LCT offers a variety of dimensions whereby specific aspects of legitimation can be analysed, this study uses only Specialisation and Semantics.

The concepts of LCT reveal different dimensions of 'the rules of the game' or the 'bases of achievement underlying social fields of practice' (Maton 2016, p3). Social fields of practice can include knowledge structures, curriculum structures and forms of learning (Maton 2009). The organising principles of dispositions, practices and contexts are conceptualised as legitimation codes (Maton 2000 - 2016). Knowledge practices embody claims made by actors, or to put it another way, when actors engage in practices they

are making a claim of legitimacy for what they are doing (Maton 2014). LCT highlights that actors' practices represent competing claims to legitimacy (Maton 2010, 2014). Knowledge practices such as the structuring of curriculum, pedagogy and assessment convey messages about what counts as the dominant measure of achievement within a field – these messages can be understood as languages of legitimation (Maton 2000, 2010, 2014, 2016). Practices assume forms that have powers and tendencies; they are 'strategic stances shaped by actors' positions and viewpoints within the field' thus the organising principles underlying these languages or practices are not neutral, and they have effects (Maton 2014 p24). Bases of achievement are often unwritten, unspoken and they go without saying in ways that, 'when accessible only to actors from specific backgrounds generate social inequality' (Maton 2016, p3). By making organising principles visible, LCT enables the bases of achievement to become accessible to more actors and in this way promotes social justice (Maton 2016). 'Any social justice agenda that excludes analysis of relations within knowledge is unlikely to succeed, for our knowledge practices are anything but neutral (Maton 2014, p13). Furthermore, making the organising principles visible also allows more rigorous critique and opens them up for challenge.

All practices are oriented towards something by someone (Maton 2010). Each relation may be strongly or weakly emphasised in practice. A specific code may dominate as the basis of achievement or as the 'rules of the game' within a field but may not be obvious or uncontested and not everyone is able to recognise or realise what is required by the practice (Howard and Maton 2011, Maton 2016). Codes are not absolute – most practices will have evidence of multiple points along any of the continua being mapped. But the key is to establish the dominant code. There may be more than one dominant code, and there are likely to be struggles amongst actors over which code is dominant.

There are degrees of code match or code clash (Howard and Maton 2011, Maton 2016, Maton and Chen 2016). Some actors within a field might draw on one code and some may draw on another and so there is a clash and contestation between such actors. Or a code clash may emerge in the epistemic-pedagogic device where a particular code underpins the practices in the field of knowledge production but this is recontextualised into a different code in the development of the curriculum. Or there might be a code

clash between the dominant code legitimated by the profession and the dominant code being legitimated in the curriculum. Furthermore, the dominant code may change over time in what is known as a code shift which changes the 'rules of the game' (Maton 2016).

Legitimation Code Theory is as an evolving theory made all the stronger for its wide application in a variety of research settings: it has for example been used for analysis of curriculum (Maton 2009, Luckett 2009, Shay 2011), pedagogy (Luckett 2012, Howard and Maton 2011), cumulative knowledge building (Maton 2009, 2011, Maton 2016, Clarence 2014) and student perceptions (Maton 2004b, 2007) amongst many others.

Specialisation codes: epistemic relations (ER) and social relations (SR)

Specialisation is one LCT dimension of the 'rules of the game' embodied by practices, dispositions, contexts (Maton 2013, 2016). Specialisation focuses on the basis of differentiation and establishes the ways agents and practices within a field are constructed as 'special, different, unique and thus deserving of distinction and status' (Maton 2004a, p90). Specialisation thus enables the researcher to identify what it is that specialises a particular field of study or practice from others.

The underlying, organising principles of knowledge-knower structures are Specialisation codes which Maton (2000-2004) developed from Bernstein's pedagogic codes, thus specialisation codes integrate classification (C) and framing (F) and bring both knowledge and knower into the picture. Epistemic relations (ER) are the relations between practices and their object towards which they are oriented. Epistemic relations are thus concerned with the relations to knowledge, skills and processes required for legitimation in the field. Social relations (SR) are between practices and their subject, author, agent enacting practices. Social relations are thus concerned with the relations to a particular disposition, gaze or way of being required for legitimation in the field. Each relation can be more strongly or weakly bounded (C) and controlled (F). Each relation can be more or less emphasised as the legitimate basis of practices and mapping such degrees of emphasis generates ER and SR of relative strengths which together give the specialisation code. It is the relations that are strongly C and F that provides the key basis to legitimacy. This means that in epistemic relations what matters

most is the knowledge; while in social relations what matters more is who has knowledge.

Codes give us insight into the organising principles for any particular practice (Maton 2000-2016). Both are always present in any knowledge claim although one may be more dominant than the other; there may also be more than one code dominant. Within a practice there may be competing codes (code clash). Specialisation codes make it possible to identify four kinds of code which can be mapped to a plane of four quadrants (signifying boundaries) along continua (signifying strengthening and weakening ↑↓ or more (+) or less (-) strength of relations). Specialisation codes can be enacted as typologies and topologies.

Knowledge code: what matters most is what you know. There is stronger classification and stronger framing of ER (+C+F) so that a field's procedures, knowledges, principles are not misapplied; weaker classification and weaker framing of SR (-C-F) where everyone is said to be equally positioned in relation to the knowledge and the practices thus (ER+/SR-)[78].

Knower code: what matters most is what kind of knower you are and whether you have the legitimated aptitudes and dispositions. Weaker boundaries and weaker control (-C-F) over legitimate knowledge (ER-) and stronger boundaries and stronger control (+C+F) over specialised kinds of knowers thereby legitimating personal characteristics (SR+) thus (ER-/SR+).

Elite code: legitimacy is based on knowledge as well as being the right kind of knower (ER+/SR+).

Relativist code: legitimacy is based on neither knowledge nor disposition (ER-/SR-).

[78] The dichotomous + and – notions were inherited from Bernstein; however the convention is rather to refer to weaker or stronger relative to a referent.

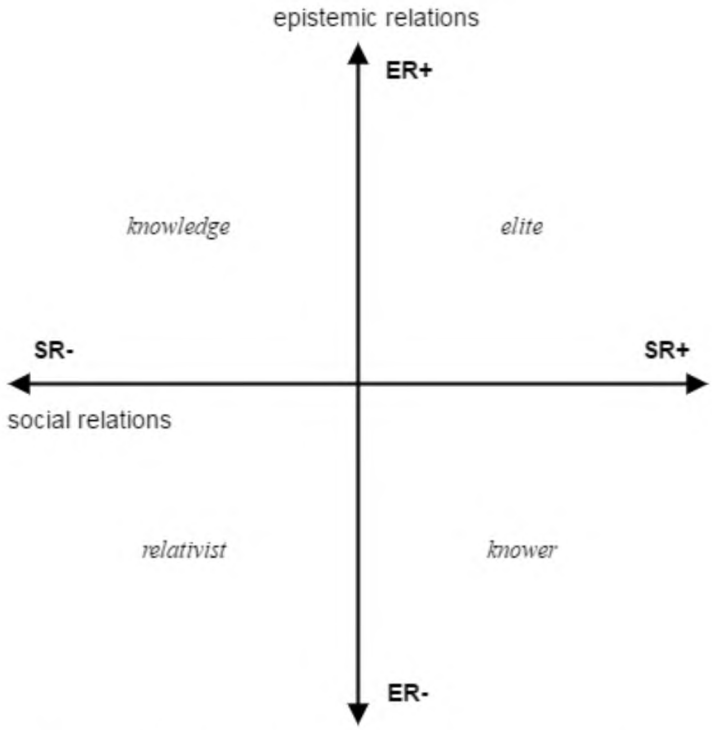

Figure 4.3. Planes of Specialisation show four quadrants representing different combinations of codes. (www.legitimationcodetheory.com/concept-glossary.html)

Undertaking a Specialisation analysis therefore entails mapping the ER and then mapping the SR and thereby trying to establish what the dominant code is. This allows us to understand the means whereby the object of analysis is specialised. LCT allows for a fractal analysis (Maton 2014) so the object of the study may be very small, such as a single paragraph within a textbook, or it may significantly larger, as it is in this study, such as a curriculum.

Semantic codes: semantic gravity (SG) and semantic density (SD)

Bernstein's conceptualisations of discourse (2000) held that horizontal discourse, which occurs in the realm of the everyday, is where meaning and understanding is largely dependent on and bound to the context. Where meanings are coherent and systematically organised, such as in the academy, Bernstein called this vertical discourse. Within vertical discourse, meanings are less context-dependent and are related to other meanings cumulatively, either in the hierarchical manner typified by the Natural Sciences, or in a horizontal manner, typified by the Humanities. From these notions of discourses and grammars, Maton developed semantic codes. Semantics refers to meanings and understandings of concepts.

Semantic gravity (SG)

Meaning can either be tied or bound very closely to a particular context, or meaning may be transferred, abstracted, generalised to many different contexts. In LCT, the degree of context-dependence is referred to as semantic gravity (SG). If the semantic gravity is strong, then the meaning is directly attached to the context in which it is made - strengthening SG entails a move from more abstracted contexts towards the more concrete and more context-dependent. In a classroom this usually occurs through providing specific examples. Weaker (-) semantic gravity is where meaning is less context-dependent and can be transferred across contexts – a more abstract realm where meaning can be used for a range of changing contexts. Weaker SG entails a move from the concrete particulars of a specific context to more generalised meanings and contexts which are less delimited (Maton 2011, 2013, 2014, 2016). The capacity to weaken semantic gravity therefore refers to an ability to transfer across contexts. Hierarchical knowledge structures realise a weaker SG than horizontal knowledge structures (Maton 2009). Refer to Table 4.3. for a summarisation.

Table 4.3. Relative semantic gravities in structures of discourse, knowledge and learning.

	Semantic gravity	
Discourse: vertical		weak(er)
Discourse horizontal	strong(er)	
Knowledge structure: hierarchical		weak(er)
Knowledge structure: horizontal	strong(er)	
Learning: cumulative		weak(er)
Learning: segmented	strong(er)	

Semantic density (SD)

In LCT semantic density (SD) refers to the extent of condensation of meanings within practices (Maton 2016). If a single term holds a corpus of meaning, then the semantic density is said to be stronger than if the single term holds a straightforward association that is widely accessible. The medical practitioner will bring to the term 'blood pressure', for example, a number of related understandings and concepts and so this term can therefore be said to have stronger SD. Analysis of semantic density can be at the level of a term, as in this example of 'blood pressure', or the analysis can be at the level of an interview, or a course guide, or a textbook. Thus strong SD (SD+) denotes a multitude or

constellation (Maton 2013, 2014) of meanings condensed within a practice. Weak SD (SD-) refers to fewer meanings condensed into a practice.

Semantic density can be used most powerfully in conjunction with semantic gravity in order to identify the dominant ways in which meaning is made within the field. Semantic codes can be enacted to explore the 'rules of the game' in dispositions, practices, contexts and just as we have come to know that a particular specialisation code may dominate 'the rules of the game' so too, a particular semantic code may dominate a practice, although this may not be obvious or transparent. Code match, code clash and code shift over time can occur.

There are four modalities (revised by Maton and colleagues in 2016) of semantic codes of legitimation that can be mapped to indicate stronger (+) or weaker (-) classification and framing of semantic gravity and semantic density:

Rhizomatic: where the basis of achievement or legitimacy is relatively context independent, relatively complex (SG-SD+)

Prosaic: legitimacy is relatively context dependent, and relatively simpler (SG+SD-)

Rarefied: legitimacy is relatively context independent, and there is condensation of fewer meanings within the practice (SG-SD-)

Worldly: legitimacy is context dependent, and there is condensation of manifold meanings within practice (SG+SD+)

As with Specialisation codes, Semantic codes illuminate the underpinning organising principles whereby a field is legitimated. The four modalities of semantic typology can be mapped in an infinite range of nuanced ways to the quadrants of a Cartesian plane. Semantic gravity and semantic density are expressed as stronger or weaker along a continuum. All practices are characterised by both semantic gravity and semantic density, and these may vary independently.

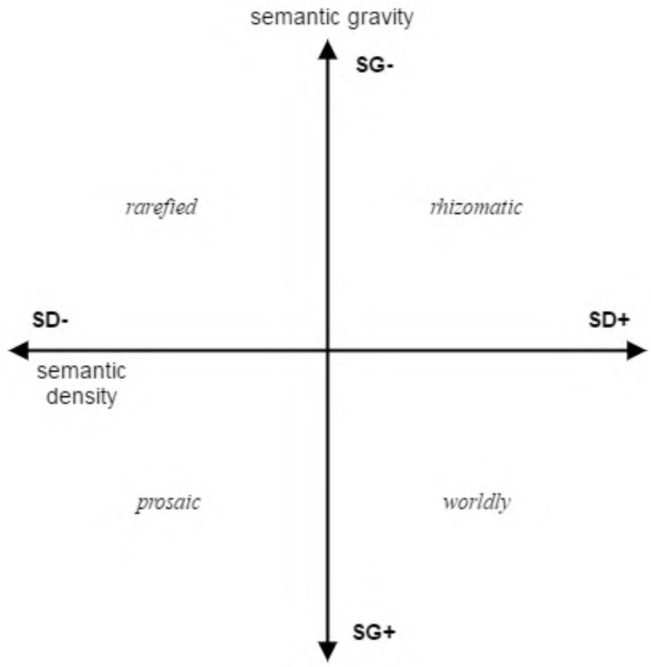

Figure 4.4. Semantic dimension can be mapped to four quadrants depending on combinations of SG and SD (www.legitimationcodetheory.com/concept-glossary.html)

Semantic profiles can be graphically represented in the form of a semantic wave or a semantic flatline dependent on what changes there are over time. A semantic profile may be an appropriate indicator for determining whether cumulative knowledge building and learning is occurring (Maton 2011, 2013). While using both semantic codes simultaneously can reinforce analysis, semantic gravity on its own can be used to analyse cumulative learning. A gravity wave reflects a recurrent process of strengthening and weakening by movement between abstraction of concepts and concrete examples: in other words the ability to recontextualise and transfer knowledge across contexts. Cumulative learning requires an understanding of the principles for recontextualising knowledge so that meanings overcome the semantic gravity of their originating contexts. Students need to be able master the semantic wave. If the ability to generalise and abstract is the basis of achievement, then many students may be set up for underachievement if they remain at a context-dependent level with limited condensation of meaning (Maton 2016). The most recent work using Semantics (Maton 2013, 2014, Clarence 2014) have demonstrated that by using semantic gravity and semantic density together, and studying the levels and ranges (profile) of these codes

over time we can get a good understanding of the organising principles underpinning cumulative learning.

The LCT dimensions of Specialisation and Semantics are simultaneous. Every object of analysis can be explored using both specialisation, to establish the means by which the field is differentiated, and Semantics, to establish the means by which the field makes meaning. They explore different organising principles that underlie the same practice (Maton 2016). The essence of my research explores whether cumulative learning is enabled for rehabilitative health professionals by the manner in which the merged foundational curriculum is structured and I use specialisation to analyse the measure of distinction of each field as well as each foundational discipline. I use semantic gravity and semantic density to explore the extent to which cumulative knowledge-building is enabled.

CHAPTER 5. METHODOLOGY

5.1 Introduction

The objective of this study is to analyse the organisation of a foundational curriculum and the extent to which it facilitates integrative knowledge-building for the rehabilitative professions. The overarching research question is as follows:

- *To what extent does the structuring of the foundational Human Biology curriculum shape students' access to professional knowledge?*

There are several interconnected concepts embedded in the overarching question, giving rise to specific subsets of research questions namely:

- *What organising principles underpin the professional practices, contexts and dispositions of Physiotherapy/Occupational Therapy?*
- *What organising principles underpin the disciplinary practices, contexts and dispositions of Physiology/Anatomy (before and after their merger)?*
- *To what extent do the structuring principles of the Human Biology curriculum enable or constrain cumulative learning?*

Specific details of data resources, and how these data were analysed and interpreted for this study are described later in this chapter. The theories guiding the substantive study, namely Bernstein's code theory and Legitimation Code Theory, have already been discussed in-depth in Chapter 4. In this section I outline how my data shapes the interpretative capacity of these theories and likewise how the theories speak directly back to data. Because I undertook research in a department where I am a lecturer, the issue of positionality is a key concern in terms of ethics and validity. I will therefore begin this chapter by considering this issue in some depth before moving on to describe strategies of data collection.

5.2 Positionality - being an inside researcher

This investigation was conducted as a case study at my home institution and thus can be referred to as endogenous research (Trowler 2011). Being an insider researcher offers both delights and pitfalls. One of the meaningful benefits is that everyday realities may

be intimately experienced and described. There exists, however, the possibility of conflict between a professional role and a researcher role, and as the insider I needed to be cognisant of the tension between these roles, and aware of personal input or inference. The value of this project depended on maintaining an objective researcher stance, which in turn meant that I needed to be reflexive in my practice, honest and open to scrutiny.

Findings emanating from this research have potential benefits for the Faculty of Health Sciences, the department, curriculum designers especially in health professional programmes, science educators and perhaps even for those on educational sub-committees of the Professional Boards for Physiotherapy and Occupational Therapy. The possibility that this research might contribute to more effective teaching and learning programmes and curricula, based soundly on principles of maximising epistemological access, encouraged me to ensure that it was undertaken with the utmost rigour.

Ethical requirements of the site university included application to the Faculty of Health Sciences' Human Research Ethics Committee for approval of the intended research; application to the Executive Director Human Resources for approval to access staff for research purposes are addressed in detail below. Furthermore, not bringing any person, department or the university into disrepute are critical tenets of ethical conduct. These principles are further explained in the ethics segment.

Reflexivity - considering how my position could influence the research

Having a career as a natural scientist has meant that I am used to doing research in a closed or semi-closed environment where variables are controlled as far as possible. In experimental biology it does not really matter what a researcher's philosophical viewpoint is, or how the researcher relates to others in society. As a scientific researcher, there never was a need for me to consider my personal position. It was of no importance how I experienced being of, and in, the world. Until I read Wellington's article (2010) I did not really comprehend why 'reflexivity' counted so much in sociological and educational research. I had not contemplated that a researcher's professional and personal position and general view of the world could have such an influence on data. I now realise that one's position, status, power and personal relations

(positionality) can affect and influence everything about data - from how one approaches the research, decides on research questions, chooses samples, selects certain methods in preference to others, and also that interpretation and analysis of data can be limited by assumptions and personal bias.

Here I address how my professional and my personal position might have bearing on different aspects of the research. Thereafter I reflect on how I determined the methods I would use to research the course with which I am intimately connected. My professional career developed from zoology and botany - essentially animal and plant structure-function or anatomy-physiology. So from early on I have appreciated the linkages between structure and function, and that having a comprehensive understanding of how organisms and bodies work, integrates anatomical and physiological knowledge. The next phase of my career saw me moving into human health, via molecular diagnostics and biochemistry to human physiology and education of health professionals. Professionally, for the past decade I have found a disciplinary niche within physiology (which includes some of the sub-specialities such as molecular biology, cell biology, biochemistry). At the time of the physical merger with the Department of Anatomy which involved a move into what is still known as the Anatomy Building, I was a staff member in the Department of Physiology. Following the educational merger my professional position with respect to the Human Biology course was as a physiology lecturer. My experiences as a staff member in the Faculty of Health Sciences, shape my understanding of how the university goes about its business, and what the university stands for - its ethos.

In relation to the professions, I know that physiotherapists are first contact practitioners (no doctor's referral necessary) who are expected to diagnose injury and dysfunction, prescribe rehabilitative exercise regimes and, importantly, who are specialised and accredited to apply hands-on treatments, physical manipulations or electrical therapeutics. The practitioner needs to know what is happening in the body at various levels beneath the outward presentation. I comprehend how critical it is that the physiotherapy professional has knowledge and understanding of functional processes which occur in the invisible realm beyond the scope of observation – physiology. Occupational therapists require basic physiology, primarily an understanding of neuro-

muscular function and dysfunction. The occupational therapist's job is primarily to holistically re-integrate a disabled or physically impaired individual into a home, work or care environment. They are not trained to, or legally allowed to apply treatments like inhalation therapy, ultrasound, infra-red or electro-stimulatory modalities, massage, manipulations or acupuncture.

My understanding of student performance, knowledge and learning comes about from my being a first year physiology lecturer, where I have witnessed the high levels of underprepared students, and poor performance in physiology tests and examinations. Approximately 22% of the whole class (physiotherapy and occupational therapy students combined) fail assessments and exams, year-on-year (Faculty Exam Subcommittee Reports 2009-2015). The conundrum of the Human Biology curriculum, with the disciplinary shifts, attendant powers and values, is the focus of this research project and arises out of both my professional and my personal experiences.

My personal position is shaped by my perception that the disciplinary identity associated with physiology, has disintegrated since the merger. Further I perceive that the place of physiology and its value/importance in basic medical education has been diluted. I make this disclosure at the outset, and it is for the research and data to corroborate or not. My feelings about the incorporation of Physiology (discipline and department) into Human Biology are shaped by the experiences and the consequences that the merger had on my colleagues. It is understood that mergers can be discomforting, because different disciplinary cultures, values, agents and powers are brought together (Fourie 1999, Mathieson 2012, Zungolo 2003). There was uncertainty, cynicism, suspicion and volatility about the educational strategy of integrating physiology with anatomy. The overall effect, for me and several other physiologists (some of whom shared their sentiments in formal representation to the university[79]), was one of marginalisation. As a scientist, and unaccustomed as I may be to acknowledging an emotional attachment to my research, this is clearly part of doing social research. Herman (2010) wrote a reflective piece on her emotional PhD journey, and advised that it is not in the best

[79] Letter of concern submitted to the Acting Dean of Science (Prof D.G.) by senior lecturer Dr D.Q accompanied by MP and GB in 2004 about the reduction of physiology in teaching courses, and that decisions about physiology teaching where taken in meetings where relevant physiology staff were not present and where minutes were not recorded.

interests of objectivity to suppress the emotions that the research process will inevitably stir up. It is with a sense of maturing as a social researcher that I admit to my own emotions related to this research – before I came in to it, while I was immersed in it, and as it concluded. Personal interests will be ameliorated by interpreting data according to the robust explanatory frameworks of Legitimation Code Theory (LCT) which was discussed in detail in Chapter Four.

On account of several orthopaedic surgeries and joint reconstructions, I have utilised the services of many a physiotherapist and been the recipient of many treatment modalities over the past two decades. I have thus been both a patient/client of rehabilitative physical therapy, as well as educating the practitioner to ensure, as far as possible, that s/he acquires the basic knowledge from which to build professional expertise. There is a professional and personal intersect in the way I understand the physiotherapy profession. I have not had direct interaction with the practising Occupational Therapy professional. Widening student access to professional courses, like physiotherapy and occupational therapy, where previously certain social groups were vastly under-represented is in line with this country's democratic imperative as discussed at length in Chapter 3. In these courses, at the research site, there is a range of student educational preparedness, student maturity and personal development, ethnic diversity, gender representivity (although males are a small minority) and home languages. Diversity and big classes arose from widening formal access. However access to the institution does not equate to epistemological access as argued by Morrow (2000) and Boughey (2005). Epistemological access to the sciences is even more of a challenge (Holtman and Marshall 2008, Muller 2015) and from personal experience of teaching first year physiotherapy and occupational therapy students I know that number of failing students in physiology is high[80].

Finally, I reflect on how my position influenced my choice of methods. Curriculum is a central focus of this study and documents will afford most information and data. The nature of the documents and the kind of data I will extract is outlined later. For enquiry into how physiology and anatomy is organised in the curriculum, I elected to interview my colleagues – lecturers on the Human Biology course. Sampling was entirely

[80] Statistics available from marks records and Faculty Exams Subcommittee schedules (personal archive).

purposeful. Reassurances were given that the study was about curriculum and the organisation of knowledge. (Because pedagogy is not what I wanted to analyse, there was no need to consider classroom observations) Interview questions were shared with the lecturing interviewees a short while before commencement. It is not clear how I may have influenced any of the participants. I did my best to establish a trustworthy and confidential space where my colleagues were encouraged to speak openly and I had a sense of there being mutual respect for the process of enquiry and data collection. In the interview process I do not believe they or I contributed to there being an imbalance of power.

For the purpose of enquiry into professional knowledge, and identifying gaps in student basic knowledge as manifest in the applied and clinical advanced studies. I interviewed a senior physiotherapist who is also a clinical educator and who had experience of private practice, and a senior occupational therapist who is also a clinical educator. Both therefore are rehabilitative health professionals as well as being educational staff within the academy. Similarly with these participants I believe that a trustworthy and confidential space was created where open disclosure was encouraged.

Trowler (2011) alerts that with endogenous research, respondents may adapt their responses in interviews because they have an idea of the researcher's alignment and preferences. As far as possible I mitigated against this by focussing the lines of enquiry very clearly on the substance of knowledge, and of curricular organisation. I would like to think that as colleagues we are all eager to bring to light any structures that might limit students' epistemological access – a well announced objective of the study. All participants, and perhaps even more so those representative of the clinical and applied domain, expressed their enthusiasm for this study because it promises to interrogate knowledge problems that have presented at various educational levels in the professional programmes.

5.3 Ethics

5.3.1 Ethical approval for data collection

Obtaining ethical approval for this research was a protracted and often frustrating affair. I needed to comply with an inordinate amount of paperwork and internal verification

stages, and this might be on account of the Faculty being more accustomed to approving animal experiments and human participation in clinical trials rather than in sociological research.

Phase one approval: Department of Human Biology Research Committee

Having had my proposal approved and been granted ethical clearance by the Faculty of Education's Higher Degrees Committee at Rhodes University, where this study is registered, I began the process of obtaining ethical clearance at the research site. This entailed my filling out an official application form wherein I outlined the research project. Thereafter the research proposal was read by two independent readers within the department who are familiar with the intricacies of qualitative research. I addressed their concerns and comments. Next, I obtained signed approvals from the chairperson of the Departmental Ethics Committee as well as the Head of Department. The internal approval system lasted about a month.

Phase two approval: Faculty of Health Sciences Human Research Ethics Committee *(HREC)*

The detailed protocol referred to above, as well as a synopsis, formed part of a comprehensive package that was submitted to the Faculty's Ethics Committee. The Consent Form for participants and a Human Ethics Application Form were also required. The researcher and supervisors' signatures were necessary for final submission to the Faculty Ethics Research Committee. The research project was approved and allocated an HREC study reference number.

Phase three approval: Human Resource (HR) Management approval

Once the formal HREC approval was granted, the next step was to obtain official endorsement from the Director of Human Resources in order to access staff for research purposes. The official HR application form was filled out, signed off by the HR Director and a senior HR advisor, and permission was duly granted to proceed with data generation from selected interview participants. Gaining ethical clearance lasted some two and a half months.

Beyond my positionality and procuring ethical clearance, there are principles of ethical conduct in research such as trustworthiness, honesty and integrity. I will now discuss

these, using Rhodes University's Education Faculty guidelines and categorisation as a template.

5.3.2 Ethical principles of qualitative research

The Education Faculty at Rhodes University outlines for its students, certain principles of ethical conduct in qualitative research and in conducting my research I complied with all the guidelines. Being respectful of participants' time and creating a relationship of trust and partnership required communicating in an open, respectful and professional manner. I informed participants of their right to withdraw from the research at any time. I also informed all interviewees of their right to remain anonymous, that I would use pseudonyms and that I would do my best not to reveal identifiers although this could not be guaranteed in all circumstances. In conducting sociological research one should to be mindful of culture, linguistics, gender and power differentials between oneself and the participants, and mindful moreover of the manner in which people and situations are represented and reported. When selecting direct quotations from data, I was mindful that these expressions were taken out of the original context, and were used instead in a newly created or contrived context. Throughout this dissertation, I acknowledge and reference appropriately the work and ideas of others.

Validity reflects the extent that particular measurements or data refer to the object of investigation and not something else (Mouton 1996). To validate research, systematic and careful records should be kept and essentially one should be able to work from the project's conclusions backwards to the raw data in order to verify the conclusions. After years of training as a laboratory scientist where every detail has to be meticulously recorded I feel this to be second nature. Legitimation Code Theory is a rigorous, evolving, widely used and well-tested exploratory and analytical framework and this contributed substantially to ensuring validity.

Informed consent is a core principle of ethical research as it means that participants have been informed of the purposes of the study, and that they have voluntarily agreed to be part of the research and comprehend their participatory role. I believe that my study's consent process was compliant with all these issues. (Signed consent forms are kept in my research archive). A consent form was presented to each participant, who

was given time enough to read through the assurances of ethical conduct, including that of maintaining confidentiality and anonymity as far as possible. The focus of the study was re-iterated, as was the purpose of obtaining interview data. Participants were advised that they could review the interview transcript, were free to remove themselves from the study at any time should they so wish, and that their anonymity would be respected as far as possible.

5.4 Methodology: from data collection to interpretation

Because social realism is the overarching sociological standpoint, this research is embedded in the assumption that there are many levels of reality occurring in an open system, with no direct relation between cause and effect. Instead causal analysis is underpinned by a diversity and variety of mechanisms that emerge in multiple perspectives and understandings. While the underlying concern motivating this study is epistemological access (and rooted in that is the issue of inclusivity), the critical foci are curriculum and how it is structured; and the position of knowledge in the foundational curriculum for rehabilitative health professionals. Curriculum and knowledge are sociological constructs underpinned by a system of values and principles (generative mechanisms) – elucidation of which are critical to my study. Previously in Chapter 3, the concepts of curriculum, knowledge and disciplinarity were thoroughly reviewed, interrogated and explained. Likewise, the two complementary theories, namely Bernstein's theorisation of educational knowledge, and Legitimation Code Theory (LCT) that frame the analyses of data have been explained in much detail in Chapter 4. In this section I describe how I will apply the theories to make meaning from the data, thus affording explanatory power to the findings.

Bernstein's theorisation of educational knowledge (code theory): certain data such as content selection, modular sequence, pace, evaluation criteria (whether espoused by teaching staff or explicit in the curriculum) speaks directly to framing and indicates where the locus of control is situated in educational relations.

Legitimation Code Theory: Specialisation (epistemic and social relations) was used to analyse the professions and the disciplines. Course outlines, curriculum documents and interview transcripts were thoroughly analysed to establish what is legitimated and

validated. The structure of the Human Biology curriculum was analysed for whether it is cumulative/integrative or segmental in macro- and micro organisation. I determined whether or not physiology and anatomy follow the principles of hierarchy and the extent of integration that has occurred. Using Specialisation and Semantic codes (predominantly semantic gravity) I reveal some of generative mechanisms underpinning the curriculum.

For this study there were two macro levels of interrogation, and analyses of these data were inter-related:

- The Human Biology (HUB) curriculum and the extent to which it establishes fundamental knowledge of physiology and anatomy, and the extent of integration in the interdisciplinary context.

- Characterisation of Physiotherapy and Occupational Therapy and exploration of the extent to which HUB curriculum forms a basis for rehabilitative professions.

The study explored disciplinary positioning in the interdisciplinary course and the extent of integration. The research analysed whether curricular and disciplinary knowledge structures, and their associated practices, enabled cumulative learning, and integrative knowledge-building which supported specialisation of clinical knowledge as required for the rehabilitative health professions.

I will now describe the resources I utilised and the purpose each served in my research.

5.4.1 Documentary analysis

This project required review of considerable documentation representing a twenty year period from 1994 which signalled the beginning of democratic education until, and including 2013. Access to faculty handbooks (abbreviated as FHB) was facilitated through my being a staff member; access to departmental and course material was possible through my direct teaching involvement.

Which documents were analysed for organising principles of practices, contexts and dispositions in the disciplines over time, and in the rehabilitative health professional

programmes over time are indicated in the following table. Lecture schedules or timetables were used for analysis of sequence and content at strategic time points.

Table 5.1. Source documents and purpose of analyses.

Documents	Purpose
1. Faculty Handbooks (1994-2013)	Analyse the organising principles underpinning Anatomy and Physiology in the fundamental curriculum for Health and Rehabilitation Sciences, from when the disciplines were strongly classified autonomous disciplines, through the merger and transition to interdisciplinarity, until the current position.
2. Faculty Handbooks (1994-2013)	Analyse changes in course descriptions, professional/graduate attributes (ideal candidates/knowers) over the 20 year study period using Specialisation and Semantics to explore the principles of legitimation underpinning the Physiotherapy and Occupational Therapy professional programmes.
3. Departmental lecture schedules (2004-2013)	Framing of the Human Biology (HUB for HRS) curriculum – sequencing, extent, content.

5.4.2 Interview data

This part of the study commenced after all necessary ethical clearance had been granted. Two sectors of academic staff were purposively selected for interview purposes (see Table 5.2):

1. Disciplinary lecturers on the Human Biology course (one for Anatomy and one for Physiology) for 1st and 2nd year physiotherapy and occupational therapy students. Each of the disciplines comprises specialised knowledge and specialist knowers with their own attributes, dispositions, experiences (and gazes)

2. Two senior academics in the School of Health and Rehabilitative Sciences who were each senior managers in their respective fields and who were matched for positional status were also interviewed. Each was ideally placed to reveal the basis of their respective professions, reflect on performance of students in the clinical arena, comment on the ideal student-knower, and voice their understanding of whether the fundamental HUB course formed a scaffolding framework on which the student could build knowledge to enable their performance in clinical studies.

Table 5.2. An overview of the objectives of generating data by interview.

Interview participants	Purpose
Physiology lecturer on the Human Biology course. Anatomy lecturer on the Human Biology course	Probe disciplinary practices for elucidation of the organising principles, and framing of curriculum insofar sequence, content and extent. Also to explore whether there was maintenance of disciplinary boundaries or integration of knowledges (Classification). Each lecturer contributes organisational principles to knowledge practices which manifest as Specialisation codes (ER and SR) and Semantic codes (SG and SD) of relative strengths along continua.
Physiotherapy senior academic and clinical educator. Occupational Therapy senior academic and clinical educator.	Questions were designed to probe the organising principles underpinning each profession, to probe what knowledge and what kind of knower is legitimated, and to probe the nexus of clinical studies and the fundamental human biology curriculum.

I approached each of the four participants by way of informal spoken and/or written request and outlined the scope and aims of the study. Upon their agreement to participate, an appointment for interview was arranged. I sent an email reminder to each interviewee closer to the appointment date and at this time the nature of the study was explained in a detailed synopsis, and I briefed each on what kind of questions to expect. A copy of the ethics approval letter was provided as an assurance of clearance to perform the study.

For the interview session, each staff member bar one who was on sabbatical leave at the time, was interviewed in their office as I thought this would be the space they experienced as most comfortable, familiar and confidential. The appointment with the sabbatical staff member was held at a coffee shop. Before commencing, the informed consent process was concluded as reported previously in section 5.3.2. Each interviewee was given opportunity to voice any questions or concerns related to the study – none were raised. Upon consent being signed, the interview process could get underway. Each participant was first given a few minutes to familiarise themselves with the

questions on the schedule placed in front of them. I did this to increase trust, so that there would be no surprises and that the intention of the interview would be clear. Participants could at any time during our interview session refer to this schedule, although I repeated each question for recording purposes. These semi-structured[81] and in-depth interviews lasted approximately 60 minutes, and the option of a shorter follow-up session was created if needed. A digital voice recorder was used to record the meeting. There were some problems with noise and disturbance while I was interviewing in the coffee shop, a public venue with consistent background chatter; and also when I interviewed in an office setting when there was initially intermittent ringing of the phone initially. Being highly sensitive to noise I think these sounds frustrated me more than the interviewees, and on playback neither incident interfered with the purpose of the session, or with the clarity of recording. Afterwards the MP3 sound file (date and time stamped) was transcribed verbatim to a Word document. In the transcript, substitute names were used for interview participants. On completion of this research, recordings will be deleted.

Although I had never previously interviewed colleagues, my experiences were unblemished by power differentials. All participants intimated some kind of relief and release at being heard and getting their points of view across and I even had one respondent saying that it had been fun. I believe that my colleagues responded fervently to questions because collectively we all want to do our best for student learning.

5.4.3 Data management and analyses

Means of analysing data generated by qualitative research are seldom made explicit and socio-educational research analysis is typically poorly explained. In the experimental sciences, communicating the details of procedures allows for open scrutiny. By publishing protocols and analytical processes similar experiments can be repeated under the same conditions in laboratories around the world and this aspect of reproducibility is crucial for validity and credibility.

Some researchers using LCT have described in-depth the various stages of data analysis and the evolution of languages of description (Bernstein 2000) emanating from iterative

[81] This allowed for follow-up and probing questions.

processes between theoretical concepts and revelations of these concepts within the data (Chen 2010, Clarence 2014, Maton and Chen 2016). Making visible the translation between theory and data and data and theory allows for the discursive gap between the two to be traversed and exposes analyses to scrutiny by fellow researchers in an open and honest way and allows others to adapt similar analytic methodologies. In this way they contribute to knowledge-building (Maton 2016).

The starting point before analysing my own data was the realisation that data analysis is an iterative process and that there is dialogue between theory and data and vice versa. This dialogue generates explanatory power. As such, and through the guidance of my supervisor, I spent the initial period of my study immersing myself in Bernstein's theories of the sociology of knowledge; and in Legitimation Code Theory with its concepts as developed by Karl Maton. Theory informs the researcher's gaze so that one can enter the somewhat murky world of data analysis with some form of sorting mechanism, some form of recognition, some lens.

Stages of the analysis process

Immersing oneself in data is spoken about as a messy process, where it is understood that the researcher moves back and forth between surface engagement and deep engagement before there is clarity and illumination. Analysing data is an iterative process. The phrase 'data keeps you honest' (personal communication K. Maton 2013) resonated with me, as it aligned with my background in laboratory sciences.

Data analysis follows a distinct process (Wellington 2010) starting with the engagement with raw data in a gentle, broad-sweep way. This encourages an overall feel for the data. Clarence (2014) speaks about immersing oneself in the data and allowing unexpected things to emerge. Those LCT proponents who have explained data analysis suggest that there should be no rush to impose theory on the data, and instead there should be an allowance for data to reveal its potential. A familiarity with the theory means that even in this early stage I was beginning to categorise data using a researcher's gaze (Maton and Chen 2016).

My initial, soft engagement involved historical, chronological and developmental narratives compiled from curricular documents (course outlines and handbooks) to

show trends of disciplinary or curricular shifts. Appendix 3.1 (page 236) gives an indication of how I applied Specialisation (ER/SR) to some of the curricular documentation.

I used an electronic data management programme (NVivo 11) for all interview data. First broad nodes (which some researchers refer to as themes) were created from emergent categories or clusters, and then through a process of refinement, which some refer to as cleaning (Clarence 2014), I created more specific sub-nodes which I could synthesise directly to a written account of findings.

The reader is referred to Appendices 3.2 and 3.3 (pages 237) which convey examples of broad nodes (NVivo) for two data sets.

In representing data graphically on Specialisation or Semantic planes, data points are plotted using a certain amount of informed approximation.

Addendum

Students' understandings and experiences of the Anatomy and Physiology course would have added to my study. However while I have access to considerable amounts of data there were ethical concerns which prevented my utilising such data while engaged in teaching these students.

CHAPTER 6. MAPPING PROFESSIONAL EDUCATION - CASE STUDIES IN PHYSIOTHERAPY AND OCCUPATIONAL THERAPY

6.1 Introduction

The analysis and findings section of my research is in two parts. Firstly in this chapter I utilise LCT tools of Specialisation and Semantics to map the professional programmes for Physiotherapy and Occupational Therapy, and secondly, in the next chapter I map the disciplines, anatomy and physiology, which form the interdisciplinary Human Biology curriculum which is a service course for the rehabilitative health professions. Together the analyses will elucidate whether the organising principles and the emergent features of the integrated curriculum are supportive of integrative knowledge-building for the professions.

My study traces changes in professional education at the university over a twenty year period beginning from 1994, which signalled the official end of apartheid and the democratisation of education nationally, through the next twenty years up to 2013, during which time there were two internal mergers. Mergers within the health sciences are not uncommon - for example nursing being assimilated into Schools of Allied Health Professions - and are often rationalised as a means to resource efficiency (Zungolo 2003). The first merger saw the Departments of Physiotherapy and of Occupational Therapy become realigned as Divisions within an amalgamated School of Health and Rehabilitation Sciences (HRS) in 2001. A second merger occurred between the Departments of Physiology and Anatomy to create the Department of Human Biology and there was a concomitant merger of the disciplines in the foundational curriculum servicing the rehabilitative professions. Previously entirely separate cohorts and attending different courses of anatomy and physiology, students of physiotherapy and occupational therapy have since 2004 attended human biology lectures together in the same class, in years one and two. It is common cause that anatomy and physiology are the basis of medicine and its allied disciplines. The focus of these knowledges is however very different in practice for physiotherapists and occupational therapists.

In this chapter, data are analysed to compare and contrast the organising and structuring principles underpinning the two professional programmes for physiotherapy

and occupational therapy in order to better understand the specialisation and distinction of each profession. Analysis is by way of LCT's dimensions of Specialisation, epistemic relations (ER) and social relations (SR), and Semantics, mainly semantic gravity (SG) and on occasion semantic density (SD). I used Faculty of Health Sciences handbooks (FHB) from 1994 - 2013 to characterise the different rehabilitative health professions as per their published course or programme prospectuses. I also analyse the organising principles from interview data generated by a clinical educator and experienced practitioner from each of the professions of physiotherapy and occupational therapy.

6.2 Organising principles underpinning Physiotherapy

6.2.1 Using specialisation to characterise physiotherapy: an analysis of course prospectuses

All twenty volumes of the Faculty handbooks (1994-2013) were reviewed for the vision statement and programme outline otherwise known as the prospectus. There were long periods where no major changes occurred and I have purposefully selected transitional periods for deep analysis. These periods are firstly 1994 which signalled the transition from apartheid to a new political dispensation; secondly, 2005 which synchronously marks the first decade of democracy and also reflects a time of considerable changes; and thirdly, 2013 which closes off the twenty year span and is a chronological end marker for this study rather than signifying any transition.

The LCT dimension of Specialisation refers to epistemic relations (ER), which are relations to the object of study, and social relations (SR), which are relations to the subject of study. All practices are underpinned by both ER, with a concern for knowledge, skills and processes, and SR, with a concern for the knower having a particular disposition, attributes and gaze (Maton 2000, 2004a, 2007a, 2010, 2014). It is the relative weakening or strengthening of these relations along two continua that allows practices to be differentiated. There are four codes which express different combinations and intersections of epistemic and social relations (ER±/SR±) and these can be plotted to the quadrants of a Cartesian plane. Organising principles speak to the basis of practices, contexts and dispositions.

No explicit vision statement was announced in the faculty handbook by the Department of Physiotherapy to students or faculty in 1994. However, the course prospectus described the programme and the physiotherapy profession in this way:

> Physiotherapy is the skilled use of physiologically based movement techniques, supplemented when necessary by massage, electrotherapy and other physical means for the prevention and treatment of injury and disease. (FHB1994, p15)

This account strongly signalled that physiotherapy is about the application of physical therapy modalities to treat injury and disease. Physiological knowledge is explicitly stated as the basis underpinning the required techniques and skills, and the student would need to comprehend disciplinary knowledge which supports the procedural knowledge. An understanding of normal function underpins the ability to diagnose and treat that which is functionally impaired, thus a thorough grounding in physiology is assumed if a physiotherapy graduate is to perform 'treatment of injury' (FHB1994, p15). The data demonstrate that legitimate knowledge, skills and procedures are clearly announced, strongly framed and strongly classified. A reminder to the reader is that classification refers to distinctions and boundaries between categories, while framing refers to the locus of control and power within a category (Bernstein 1996, 2000 and refer Chapter 4). Epistemic relations are especially strong (ER+) and having particular knowledge and skills is key to specialisation in physiotherapy.

There was some evidence to indicate that having a particular gaze (Maton 2007a, 2014), disposition or set of attributes is valued but these were in the 1994 data fairly generic and not consistently foregrounded, which indicated a weaker emphasis on social relations at that time (SR-):

> Candidates for the degree must be of strong physique and should have a wide general education and be interested in human relationships. (FHB1994, p15)

With a strong message conveying that epistemic relations are valued and form the basis of achievement and much weaker emphasis on social relations, the underpinning

principles of the early (1994) Physiotherapy programme can be regarded as (ER+/SR-) or a dominant knowledge code.

The influence of prevailing discourse favouring applied disciplines which are directly relevant to society (refer chapter 3, and Allais 2012, Ensor 1998, Muller 2009, Muller and Young 2014) can be seen to influence the programmes as outlined in prospectuses. The Faculty handbook of 2005 announced that 'Physiotherapy is an applied discipline dedicated to the study of human movement and function and its relevance to health and well-being'. In an almost identical statement it was pronounced that 'Occupational therapy is an applied discipline dedicated to the study of occupation and its relevance to health and well-being.'

At 2005 and remaining unchanged since then, the Division of Physiotherapy in the School of Rehabilitation Sciences, according to Faculty handbooks, positions itself as (or becoming) a world-class educational facility, graduating physiotherapists who will meet the challenges of physiotherapy practice and scholarly pursuit - this much is announced in the vision statement:

> ...the Division strives to be a world-class, African Division of Physiotherapy and is committed to the Primary Health Care approach of educating physiotherapists who will be well prepared to meet the health, rehabilitation and research needs of our country. (FHB2005-13)

The claims for professional education start off with lofty idealism – 'world class' and then become more and more context-dependent from 'African' to 'our country' depicting the localised context. What is reasonably clear from the vision statement is that the Division of Physiotherapy foresees educating and graduating its students as knowledgeable and skilled rehabilitation practitioners able to meet the challenges at all levels of the South African health system, and furthermore these graduates are expected to contribute to scholarship within the profession.

It would seem that the envisaged graduate who emerges from this training is required to know much, and to be much; a healthcare worker, rehabilitation expert and scholar, in many different professional and occupational contexts. Underpinning all these roles are

strong epistemic relations, and moreover there are strengthening social relations especially if one considers that embedded in the primary health care approach (WHO Alma Ata declaration 1973) is a bio-psychosocial focus on the patient or client, by the practitioner. The espoused values suggest specialisation of the physiotherapist is organised by stronger ER and stronger SR or (ER+/SR+).

> …physiotherapy involves the skilled use of physiologically-based movement techniques, supplemented when necessary by massage, electrotherapy and other physical means, for the prevention and treatment of injury and disease. It is used to assist the processes of rehabilitation and restoration of function, including the achievement of personal independence…
>
> The programme is designed to equip students both academically and professionally with the skills and clinical expertise required to practise competently and confidently within a variety of healthcare settings. (FHB2005-13)

Physiotherapy strongly announces that the programme forms the basis of skills development and that clinical expertise specialises the profession. Clinical expertise furthermore conveys the notion of epistemic ascent - essentially ascendency from novice to expert through structured levels of more complex, integrative learning - (Winch 2012 and refer chapter 3) and the development of clinical reasoning. There is explicit stipulation that physiological knowledge is valued. The strong underpinning of practices on knowledge, skills and procedures - epistemic relations - is further unequivocally emphasised by the statement that the Division of Physiotherapy 'foresees educating and graduating its students as knowledgeable and skilled rehabilitation practitioners' (FHB2005-13) who are also well prepared to do research. The basis of specialisation is thus stronger than before on epistemic relations, and possibly by emphasising the physiotherapist researcher, the statement may signal stronger social relations.

At the same time more is required of the student to adhere to a dress code and look a certain way, and also behave according to the norms stipulated by the programme. The

elements of student attire and uniform underscore how a student demonstrates outwardly that s/he is becoming a member of a professional community and cultivating an identity. The strengthening of the social relations in the 2005 handbook data was not only in relation to dress. It included also references to disposition, attitude and characteristics:

> Students will be required to wear shorts and T-shirts for practical classes. As physiotherapy is a practical discipline, students will be expected to disrobe for some of their practical classes. They will be expected to wear suitable navy trousers and a prescribed white shirt for their clinical practice...
>
> Candidates for the degree programme should be interested in human relationships and have a strong commitment to service within the field of healthcare. (FHB2005, p41)

Data indicate a shift towards stronger social relations with more focus on the ideal candidate being an individual who has the attitude and capacity to be strongly committed to service and healthcare, and be someone who is interested in human relationships.

Thus, as shown by prospectus data, a knowledge code (ER+/SR-) specialised physiotherapy in the first decade. This means that at that time knowledge, techniques and skills were strongly legitimated, and dispositions and knower attributes were seen as less significant. At the decade juncture or midway mark of 2005, the data suggest that the professional programme became more distinctly specialised by even stronger epistemic relations based on a firm understanding of physiology - human function and movement - with a need for skills and clinical expertise. At the same time a practitioner's competence was underpinned by the individual's capacity to form human relationships and serve, and the physiotherapist was also expected to identify as a researcher and scholar – thus there was simultaneously a stronger emphasis on social relations. The data signals a code shift at the end of the first decade towards an elite code (ER+/SR+) where physiotherapy is specialised by both knowledge and the social characteristics that

the practitioner needs to bring to professional practice. The code shift changed the 'rules of the game' (Maton 2016).

At 2013 there were no substantive additions or changes. Instead the prospectus retained the modifications and developments noted at the previous data point of 2005, marking the first ten years. This suggests that the dominant specialisation code has remained essentially stable over the past decade. The physiotherapist remains specialised by knowledge – especially oriented to physiology and function - and by skills, procedures and applications of physical and electrical therapeutic modalities in clinical settings. At the same time, physiotherapists-in-the-making should be interested in human relationships, committed to serve, and are expected also to have scholarly attributes. The elite code (ER+/SR+) is maintained.

By using three time points to depict milestones, the measures of distinction or bases of achievement underpinning the Physiotherapy programme can be mapped. A shift in dominant code from knowledge code (ER+/SR-) to elite code (ER+/SR+) signals the end of the first decade; also noteworthy is that there were no further shifts over the final decade to 2013 and elite coding is retained as before.

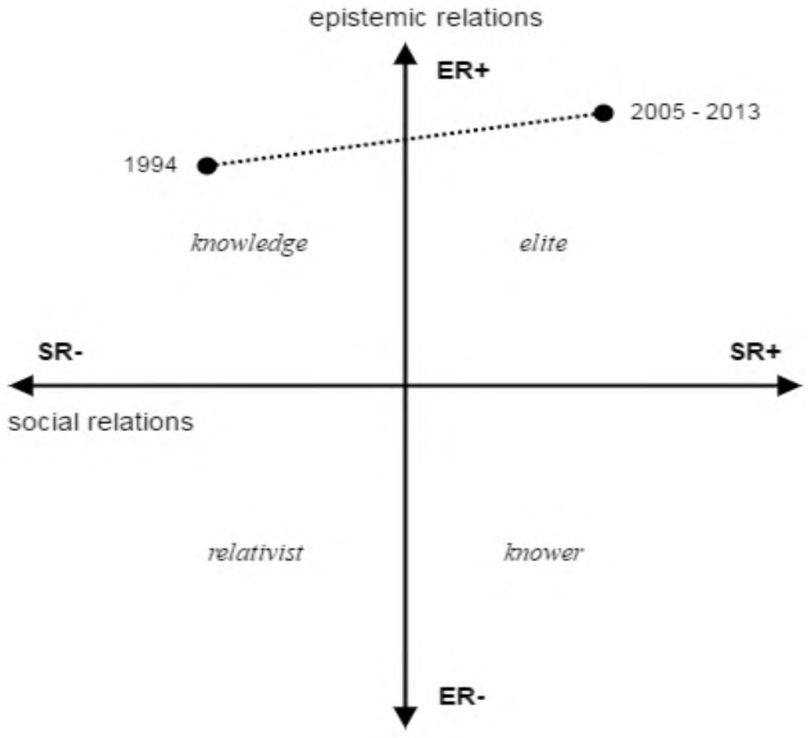

Figure 6.1. Depiction of the principles underpinning the Physiotherapy programme

The elite code that has characterised physiotherapy for at least the past ten years can be plotted with the ER point high up on the epistemic relations continuum, and the SR point is concomitantly quite far advanced on the social relations axis. In attracting neophytes to the field the epistemic requisites are clearly and boldly announced – a physiological basis is specified, as are the social relations. For the student to understand the 'rules of the game' (Maton 2016, p3), then what counts as the dominant measures of distinction and achievement in the field need to be obvious. The Physiotherapy programme is explicit in this regard.

6.2.2 Analysing the requirements of clinical practice using semantic gravity and semantic density

To analyse the contexts in which students were expected to apply their learning, I selected prospectuses from the same time periods as previously used, which mark the beginning of democratic education in 1994 and the decade milestones thereafter. Semantic gravity (as explained in chapter 4) is a useful tool to explore how context-bound a practice may be. Semantic gravity (SG) allows us to take into account the extent to which the knowledge is closely tied to one specific context (SG+) or the extent to which the knowledge has been abstracted and can be applied across multiple contexts (SG-). For example: stronger SG could refer the context of a particular patient with a particular injury; weaker SG could refer to the various physiological processes underlying the injury. Diagnosis and treatment entails weakening and re-strengthening SG.

Beginning at 1994, there is a need, though somewhat understated, that learned practices are required to be used in contexts other than the ones in which they may first be introduced, as seen in the following:

> Students will be required to carry out clinical practice in a number of institutions and clinics. (FHB1994, p15)

Students are expected to have acquired the ability to transfer knowledge and skills to different work contexts or environments. The ability to transcend a particular context and apply knowledge in a variety of diverse, complex clinical situations is enabled by cumulative disciplinary learning (as explained in Chapter 3). The student needs to learn how to weaken semantic gravity (SG) and apply knowledge across contexts.

By 2005 far more is required of the physiotherapy student, who is expected to practise competently not only in a variety of healthcare settings, but also in a variety of geographic, demographic and socio-economic locales. The student is expected to apply her learning in numerous, diverse contexts as is clearly depicted in the following:

> The programme is designed to equip students both academically and professionally with the skills and clinical expertise required to practise competently and confidently within a variety of healthcare settings, including hospitals, clinics, community health centres, special schools, homes and other community-based facilities. Accordingly, students will be required to carry out clinical practice in urban, peri-urban and informal settlements. (FHB2005, p41)

Claims are thus made that the teaching programme is designed or structured such that it will confer on students the skills which are required to practise in many workplace contexts. This implies that the course or curriculum 'equips' the student to weaken semantic gravity (SG) according to requirements of the clinical context. An explicit claim is that the programme provides the academic and professional basis for clinical expertise. To transfer learning across multiple contexts refers to an ability the student-knower needs to acquire to transcend boundaries (see Chapter 4) - an aptitude which has its foundations in a disciplinary way of knowing (Wheelahan 2007, 2010, Winberg et al 2016). The prospectus clearly mirrors the Primary Health Care approach by announcing the different levels of care namely clinics and community health centres which constitute the primary level, and hospitals which constitute secondary and also tertiary level. The nature of how primary level healthcare is structured makes it a more challenging milieu for the student physiotherapist and that is because this level of care requires reasoning, assessment and diagnosis frequently independent of the medical practitioner and frequently independent of the supervision of a qualified physiotherapist.

It is note-worthy that between 2005 and 2008 the prospectus announced that: 'The curriculum is currently undergoing revision and it is envisaged that there will be an

increasing focus on problem-based learning in future' (FHB2005-08). This announcement was removed from the 2009 edition and problem-based learning has not transpired.

Marking twenty years, the 2013 prospectus reflects identical wording and thus makes the same claims for the programme that were stated a decade earlier (2005). The student needs a very sound command of integration and abstraction, and moving up the semantic gravity continuum in order to put knowledge to work and apply learning across diverse clinical and social contexts.

As for semantic density (SD), all prospectuses underscore and define a physiotherapist as a professional who treats injury. There are a constellation of meanings inherent in the term and practice of 'treatment' (FHB1994-13) making it semantically dense or SD+. Treatment involves 'movement techniques' and/or 'massage, electrotherapy and other physical means' for 'processes of rehabilitation' and 'restoration of function' and the message of strong semantic density inherent in physiotherapy practice was strongly announced in all faculty handbooks (1994-2013). Documentary analyses demonstrate that strong semantic density (SD+) and weak semantic gravity (SG-) characterise legitimacy of the practitioner. The basis of achievement being relatively context-independent with a complexity of meanings, suggests a rhizomatic code (SG-/SD+).

6.2.3 A physiotherapy clinical educator perspective: knowledge and knowers

Augmenting documentary data, this section of the analysis reflects current day, real-time expectations of the clinical-knower and graduate-professional from the perspective of an experienced physiotherapy professional. An in-depth interview was held with a senior academic and manager in the Physiotherapy Division whose lecturing experience is predominantly with the more advanced students in years three and four. This academic also contributes to curricular matters, and was previously a physiotherapist in private practice. I considered this interview participant ideally placed to reflect both inward to the knowledge foundations of the profession and outward to the graduate or professional knower. I use the pseudonym René to protect identity. I explore the basis of the profession from the perspective of the professional, and I use specialisation and semantic gravity to do so.

When René was asked what she envisaged the purpose of the human biology course to be, she responded that:

> The purpose of human biology is to provide our students with the core knowledge of anatomy and physiology that underpins everything that we then teach in the profession-specific courses later. (…) Because all of their profession-specific courses rely on that basic level of knowledge that we expect them to acquire in human biology.

It was emphatically stressed that anatomy and physiology knowledge forms the basis for further, advanced courses. This is a hierarchical knowledge structure (Bernstein, 1996 2000) where expectations are that human biology provides the platform which underpins advanced studies; and that human biology is subsumed and integrated into the specialised, principled knowledges of the profession. It is relevant now to look deeper into the extent to which human biology helps to build further professional knowledge:

> …knowledge required for movement science is a thorough knowledge of anatomy but also a thorough knowledge of physiology in terms of muscle structure and function, healing processes, exercise, physiology of exercise, you know, movement sciences is very exercise prescription orientated so there needs to be a good understanding of the physiology of exercises in order to do applied exercise prescription …

Cumulative learning (Maton 2009, 2010, 2013, 2014) typifies knowledge-building and specialisation in physiotherapy. Applied Physiotherapy, as outlined by René, is one of the courses where professional knowledge is unequivocally built by integration of previously learned anatomical and physiological knowledge:

> Applied Physiotherapy which they start in second year and they do in second, third and fourth year. Applied Physiotherapy includes neurological physiotherapy and cardiorespiratory physiotherapy. So, on the anatomy side they need to have a thorough knowledge of the anatomy of the cardiorespiratory system. They also have to have a thorough knowledge of neuro-anatomy to underpin the physiotherapy

> treatment assessment, application of techniques as – as applies to those systems. Physiology wise, they need to have a good understanding of cardiorespiratory physiology you know … in their third year they do quite an intensive neurology course where they look at assessing and treating head injuries, strokes (…) and they need to have a good grasp of neurophysiology to understand the pathology on top of that.

René emphasises that the ability to perform an assessment underscores the application of treatment modalities, and the capability to perform an assessment is indisputably based on specific underpinning knowledge of anatomy and physiology. Key to specialisation in physiotherapy is that higher order cognition is cumulatively and integratively built on fundamental knowledge For example, a good grasp of neurophysiology is needed in order to 'understand the pathology on top of that' (René) which speaks to the necessity that the physiotherapist-in-training be able to integrate core fundamental conceptual knowledge into a diversity of complex contexts by weakening semantic gravity (Maton 2013, 2014).

> …in fourth year in applied physiotherapy (…) they have to work in intensive care environment … they have to understand acid base balance. They have to be able to stand at the bedside of a patient, read charts, interpret information and understand that on a basis of physiology … that they should be – we expect them to be learning in human biology - which we find that they're not actually getting in human biology. (René)

In the final year students are expected to interpret patient charts based on integration of their physiology learning; the Applied Physiotherapy course requires students to transfer acquired knowledge and understanding to increasingly complex environments, such as intensive care, and to perform in diverse work situations they require the ability to weaken semantic gravity (SG-). The ability to put knowledge to work (Evans et al 2010, Winberg et al 2011, 2013) in the case of clinical physiotherapy requires a mature, sophisticated and practised ability on the part of the student-knower to integrate

knowledges, apply reasoning and assessment skills, make a diagnosis and treat. The situation places an onus on the trainee to move instantaneously up the semantic gravity scale from a context of the learned basics to an application of integrated knowledge in a live environment. The following extract from Renés interview describes well the demands of clinical engagement - she continually linked the underpinning basic knowledge needed for the principled propositional and procedural knowledge:

> There is then the third course which is Clinical Physiotherapy which is where they then take this knowledge and apply it with patients. So that's their clinical learning environment where they need to integrate everything. So the Applied Physiotherapy and the Movement Science are classroom-based courses where we do case studies, paper-based patients. But Clinical Physiotherapy is where they get the reality of the person sitting in front of them and then have to apply it and integrate it. And that – that is – requires a thorough founding in Human Biology because it's the added social stress and the environment then - you know -brings a whole new twist to what they're trying to do. And it's that much harder for them to think clearly when the person is sitting in front of them.

From the perspective of this experienced clinical educator, the ideal student incoming to clinical and advanced physiotherapy studies is someone who understands that the biomedical sciences form the basis for more specialised knowledge, and that new knowledge is built by cumulative, integrated learning.

> …one who can tick the boxes in certain knowledge areas. You need to know certain things, okay. But we also need a student who comes out at the end of the course with a thorough understanding that this course underpins everything that I do in my profession and the importance of this course. So, not a student who goes oh, well, I've passed it and I can walk away from it but a student who understands that I refer back to it in everything that I do throughout my professional career. Because that's the knowledge that underpins

> everything that we do … because it – it underpins my reasoning with treating patients. So – so the student needs to come out with a certain knowledge level of just knowing stuff but also an understanding that it underpins assessment and treatment of patients.

The ideal student-knower is required to be an agile thinker, someone who has the ability to scaffold and connect bits of information, someone who has the attitude of a problem-solver and someone who understands that reasoning power comes from grounding in the basic knowledges. The academic emphasises that strong epistemic relations and also strong social relations are the basis of specialisation in physiotherapy – an elite code (ER+/SR+). There is a clear sense that the kind of knower considered as ideal is one who is adept at linking basic knowledge with an upstream ability to problem-solve. The expectation of students is that they acquire the ability to weaken semantic gravity drawing on fundamental knowledge for their analytical reasoning, situational assessment and treatment of patients in a demanding clinical environment:

> I'm not expecting a student to come out of a human biology course with the problem-solving. That is I think – how do you describe it – an iterative process and that they learn those problem-solving skills with exposure and the clinical learning environment and as they mature as professionals, I know that that takes time but an understanding and a recognition that it's – that the knowledge from human biology is one of the key concepts and that's key knowledge that underpins that problem solving approach. And – and also an understanding in – in approaching human biology topics that 'I might not know it all, but with basic knowledge I can work it out.

These data corroborate documentary analysis revealing that the profession of physiotherapist is specialised by an elite code strongly (ER+ / SR+). It is specialised on the basis of knowledge and it is specialised on the basis of the knower having certain attitudes, attributes, and abilities to put knowledge to work. Putting knowledge to work requires an adeptness to weaken semantic gravity in order to integrate knowledge and apply learning to complex, diverse and demanding work contexts.

Physiotherapy practices, dispositions, and contexts are built upon the foundations of physiology and anatomy. If students are unable to realise the principles of weakening semantic gravity that are required to work across contexts, and if students are unable to recognise the epistemic basis from which to draw, then students will not succeed. In other words, if students are unable to recognise and realise (Morais et al 1992) the elite code that specialises the profession, they will not succeed.

I have found that Physiotherapy, via the prospectus, announces its elite code to incoming students, and moreover explicitly specifies the epistemic basis of the profession with a special emphasis on physiology. Whether the curriculum forms the appropriate basis for integrative knowledge-building in physiotherapy are questions that are explored in the next chapter.

6.3 Organising principles underpinning Occupational Therapy

6.3.1 Using specialisation to characterise Occupational Therapy

As outlined in the previous case, I use the same three time points (1994, 2005, 2013) to explore the organising principles underpinning the practices, contexts and dispositions of occupational therapy as written into Faculty handbooks.

The department declared in the early record that:

> Occupational therapy is a service profession. Its primary aim is to help people in practical ways to overcome health related problems and to develop their abilities, in order that they may function independently and effectively at home and during leisure time. (FHB 1994, p14)

The professional is specialised as having the 'practical' know-how to develop a client's ability to function effectively after health has compromised this ability. There is a practical and procedural base to this claim, and there is also a propositional basis to understanding health problems. These together indicate epistemic relations as the underpinning principle although this is not strongly emphasised, and it is considerably weaker than in the case of physiotherapy which specifies the kind of knowledge, and the kind of procedures and applications of the profession.

> The course is designed to give students insight into human functioning in health and illness, to provide opportunity for personal and professional growth and to enable graduates to render an important service in the community. (FHB 1994, p14)

The programme's dual purpose is reflected by the intention to develop students' understanding of human function in health and in illness as well as to provide opportunities for personal and professional growth. Occupational therapy does not strongly announce epistemic relations preferring the term 'insight' rather than knowledge, and referring to 'human functioning in health' (FHB1994, p14) rather than the explicit pronouncement of physiology-based knowledge that was the case with physiotherapy. There is also a stronger emphasis in occupational therapy on development of the person, her attitude, disposition and habitus which would indicate strong social relations underpinning the practice. Because knowing about human function in health and illness requires necessary knowledge and understanding of processes and concepts, I would claim that a weakly specified knowledge code underpins the practice. Comparing and contrasting physiotherapy's pronouncements at 1994, I would map occupational therapy weaker on the epistemic relations continuum and stronger on the social relations continuum.

If we move to the 2005 data, we see the following statement of purpose from the occupational therapy department in the Faculty handbook:

> The purpose of this programme is to educate students to become professionals who can help to change people's lives by facilitating their engagement in occupations that are appropriate to their environment, background and health needs. (FHB2005, p39)

The emphasis is on who the occupational therapist needs to be; she needs to become a life-changer and a facilitator, and also a professional who is to understand a client/patient's occupational circumstances, social background and health needs. What matters are the humanistic characteristics of the subject, and the student-knower and the ideal occupational therapy professional are typified by strong social relations (SR+). Relations to knowledge, skills and procedures are rather understated, for example, 'educate students to become professionals' and in one instance rather obtuse 'by

facilitating their engagement in occupations that are appropriate to … health needs' (FHB2005). Epistemic relations are weakly emphasised. From the perspective of its departmental vision, occupational therapy is ostensibly more knower-oriented than physiotherapy:

> Students are encouraged and enabled to become self-directed and life-long learners. The profession requires mature people with integrity who are creative and innovative thinkers, good communicators and committed to service. (FHB2005, p39)

Compared to earlier versions, the 2005 prospectus evidences an increased emphasis on student's dispositions, attitudes, behaviours and habitus. This is indicative of a considerable strengthening along the social relations (SR) continuum, the extent of which is not matched on the epistemic relations axis. Occupational therapy practice therefore cannot be plotted as high up on the ER continuum as physiotherapy and may be stronger on the SR axis. The overall shift is to (ER+/SR+) an elite code. The wording of the prospectus of 2013 is identical to 2005, indicating a period of stability with no shifts and thus occupational therapy maintains its elite code with more of an emphasis on social relations.

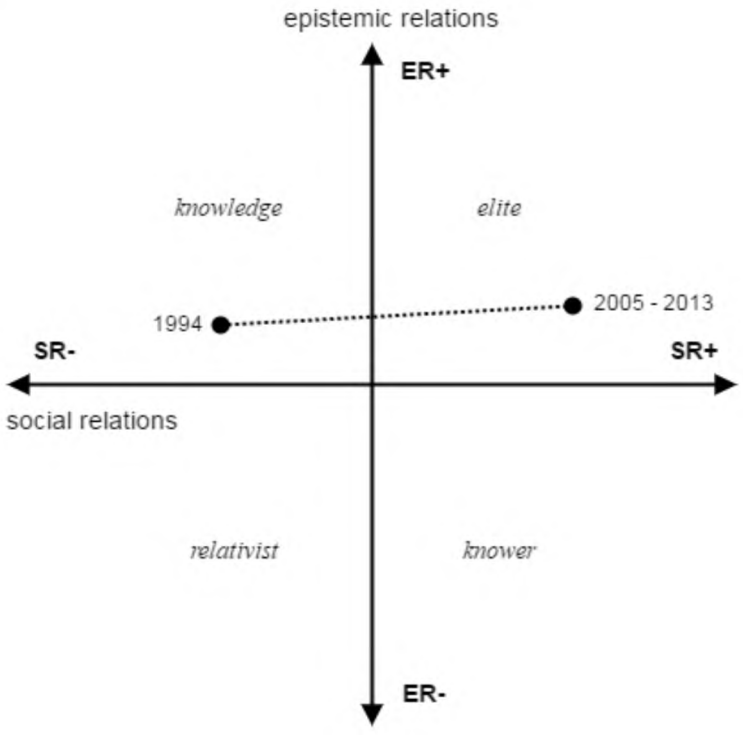

Figure 6.2. Depiction of the principles underpinning the Occupational Therapy programme.

In summary, occupational therapy underwent a shift from a knowledge code relatively weaker than physiotherapy and for the past ten years may be characterised by an elite code with a strengthened position on the social relations continuum. In contrast to physiotherapy, epistemic requisites are not boldly announced and the epistemic message to neophytes entering the field are not transparent. The link between the profession and how the basic sciences curriculum is meant to serve the course ideals is obscure and this too is in direct contrast to the case of physiotherapy. I would argue that the 'rules of the game' (Maton 2016, p3) and what counts as the dominant measure of achievement for the profession is conveyed in a message where strong emphasis is placed on attitudes, behaviours, dispositions – the social relations component of the elite code.

6.3.2 Analysing the requirements of clinical practice using semantic gravity

Data for this analysis were obtained from faculty handbooks. The 1994 prospectus states that the therapist is required to use her learning and extend it to solving the client's occupational problems at home and in the leisure space. Various occupational (dis)abilities may result following trauma or illness and these may occur across all ages of the lifespan. The student requires the ability to weaken semantic gravity to transfer meaning to broad contexts at 'home' and 'leisure', to help clients cope and adapt:

> …help people … to develop their abilities, in order that they may function independently and effectively at home and during leisure time. The service is available for people of all ages whose lives are complicated by sickness, trauma, developmental delay or the inability to cope and adapt to circumstances and to the environment. (FHB1994, p14)

At the decade mark, 2005, there are minor changes requiring that the student has a good understanding of social and occupational contexts as is evident from:

> The purpose of this programme is to educate students to become professionals who can help to change people's lives by facilitating their engagement in occupations that are appropriate to their environment,

> background and health needs (….) preparing graduates to make a contribution to the practice needs in our country. (FHB 2005 p39)

Statements at 2013 are unchanged from those a decade earlier. Somewhat obscured, the statement about 'preparing graduates to make a contribution to the practice needs in our country' (FHB2005 – 13) means preparing graduates who can apply themselves at primary level (clinics/ community healthcare centres / day hospitals), secondary level (regional and specialist hospitals) and tertiary level (academic training hospitals). The requirement for students to transfer their learning across several, diverse contexts remains quite a consistent demand as expressed in the prospectus across the twenty year study period.

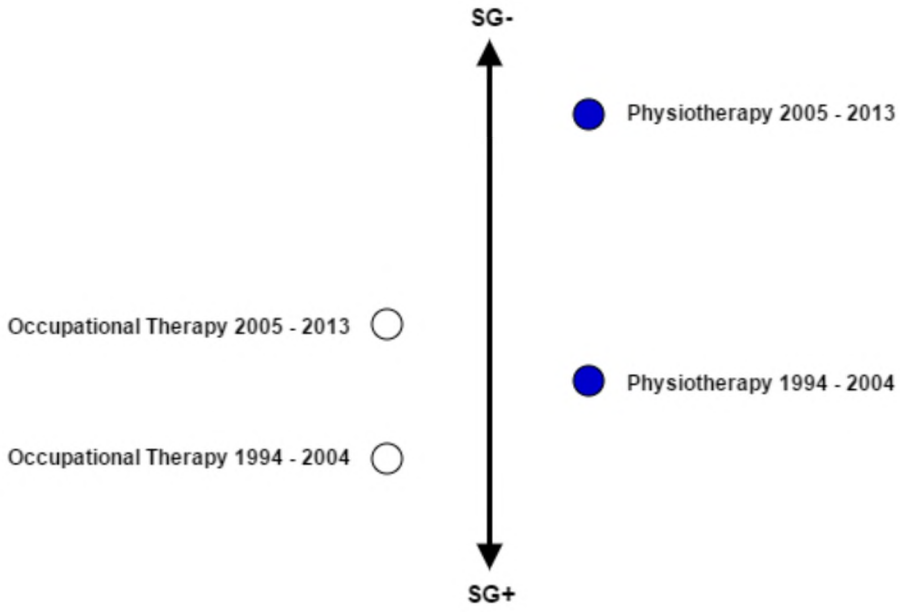

Figure 6.3. Physiotherapy and Occupational Therapy plotted by context-dependence of graduate practices as espoused in prospectus by respective departments.

In summary, physiotherapy's documented requirement for the graduate-knower to transfer learning across multiple contexts (also called recontextualisations by Evans et al 2010) is reflected by a steep increase to the time point at 2005 in Figure 6.3 reflecting considerable weakening on the SG continuum. There is no documented shift from 2005 through 2013.

Occupational therapy's requirement of the graduate to transcend boundaries and transfer knowledge across multiple diverse contexts is espoused less emphatically in

documents than is the case with physiotherapy. The contextual demands of practice are not much different at 2005-2013 than 1994.

The lived experience and expectations for semantic gravity weakening and cumulative learning are addressed in the next section 6.3.3.

6.3.3 An occupational therapy clinical educator perspective: knowledge and knowers

This section of the analysis reflects current day expectations of the occupational therapy graduate-professional. I interviewed a senior manager and senior academic in the Occupational Therapy Division whose lecturing experience is predominantly with the more advanced students in years three and four. The occupational therapy interviewee matched the physiotherapy interviewee according to parity of managerial and academic position, and parity in the oversight role that each candidate had of departmental curricula. I assigned the pseudonym Ella to this professional.

In wanting to find out what knowledge the Occupational Therapy Division regarded as the basis of profession, I posed a question about the purpose of the human biology curriculum and it was answered as follows:

> Yes, for us, it's a course that lays the foundation to understanding the human body. The structure and function of the body and with a particular focus on systems in the body that explain pathology one, but also … dysfunction … so body structures that aren't what they should be in order to enable function and participation in everyday life. Without HUB there's no way that our students would understand clinical sciences and the aetiology of some of the [inaudible] conditions that … are organic.

In stark contrast to the manner in which the interview data about physiotherapy specifies how physiology and anatomy are the basis of physiotherapy practices, the occupational therapy interview data obscured the basis and generalised to an 'understanding of the human body'. Epistemic relations were far weaker than in the physiotherapy interview. The epistemic message from the representative is somewhat confusing, for example dysfunction can only be conceptually advanced from a basic but

thorough understanding of normal functionality. There are no 'systems … in the body … that explain … pathology … but also … dysfunction' (Ella). Integration and subsumption of the basics into specialised knowledge is implied but the linkage and the basis are tenuous, such as the claim that 'without HUB there's no way that our students would understand clinical sciences' (Ella). Integration and subsumption of prior knowledge is assumed, although as in the afore-mentioned case of pathology and dysfunction the knowledges that form the basis of the integration remain unclear. Integration requires of the student a sophisticated ability to weaken semantic gravity which is not necessarily signalled to the student but is nevertheless expected by the clinical educators. The expectation that students apply their learning to an expanding array of contexts, such as assessment and treatment, is further exemplified in the following extract:

> So in second year our students do a whole module of sensory motor assessment. So the assessment of range of motion, muscle strength, endurance … neurological … functioning. So without that, without HUB it's a problem. … And then in third year, students begin to also use treatment modalities within physical rehabilitation as part of occupational therapy that's reliant on HUB.

Furthermore, stronger epistemic relations become apparent for at least a second year and a third year module where the therapist is specialised by her use of knowledge, procedures and skills to assess muscle function and employ certain treatments during physical rehabilitation. The data indicated that there is a transition at a specific point in the programme where social relations (SR+) are emphasised as the measure of success and the student's ability to engage and form a caring relationship with a client matters most:

> We have function based occupational therapy which is about working towards ability. So for instance, the ability to pick up a pen and write and write legibly is a function. And then the third level we call occupation-based practise where it is about engaging in context where what matters most to that individual, is the focus.

A tension seems to exist about what exactly legitimates the profession. The passage below indicates a response to a question about who the ideal student may be:

> There's a student who understood and mastered HUB … but sees the link with what they're going to do as an OT as well. As students who do well in HUB but don't see the link with what they would do as an OT … ja they – I think there is a – I think we failed them.
>
> Because they have obviously found their feet and grounded themselves very well within HUB, understanding the body, understanding its function, understanding movement and all of that but will not necessarily serve humanity using OT as a vehicle.

Students need to understand that strong epistemic relations (ER+) form the basis of the profession and to ground themselves in human biology. They are at the same time expected by the lecturers/programme to figure out early in their studentship that it is instead stronger social relations (SR+) that characterise the profession. Even if they are successful in the human biology course, this does not count as legitimate, according to Ella the academic unless the student integrates this knowledge to 'serve humanity using OT as a vehicle'. It is incumbent on the occupational therapy student to understand that in order to be successful the 'student will integrate it themselves' (Ella) and that unless they understand the purpose or the focus they 'will not necessarily serve humanity' (Ella).

Representing the profession, Ella emphasised that the student-knower is expected to have certain characteristics – she is expected simultaneously to be a problem-solver and a reflective practitioner working in a 'fast-pace' environment (as community healthcare settings often are). The OT lecturer mentioned:

> And we train our students to problem solve. And sometimes you know, problem solving and reflection gets in the way in a fast pace kind of setting.

It is unclear how it was envisaged to train problem-solving but Ella's phrasing thereof suggests a process or procedure, which indicates an epistemic basis. Yet Ella speaks to

the 'social sciences' aspect of OT – 'reflection' - and described a tension between this disposition and the ability to 'problem solve'. It seems that epistemic relations and social relations are somewhat at odds.

Strong social relations are legitimated in preference to epistemic relations in certain workplace or client contact situations. In the following example the ideal knower is required to be a listener rather than treatment focussed: 'so we don't want students who would force the contracture out of that elbow with the limited time that they have with that rehab service user (…) instead what the person is saying is more important for them.'

In her role as an academic, Ella appears to recognise that rote learning of human biology impedes the student's ability to weaken semantic gravity: 'in fact, students who are not strong in HUB would struggle in applying what they might have learned you know in rote. They can't explain if a client presents with just a shift in something that they can't respond appropriately.'

Even the final year occupational therapy student seems to struggle with applying her knowledge in different contexts having not acquired the skills to weaken semantic gravity. Ella indicated that during work assessment where the final year student should 'be able to assess properly' she will instead 'fall apart':

> So we used to have students who failed 4th year because when they are placed at a place like work assessment, GSH[82,] where you have a person coming in, you need to asses them in order to inform employers of whether they can return to work or whether they qualify for a disability grant, the student will fall apart. Because they – that's what they're working with the body structure, they need to be able to assess properly.

The occupational therapy academic programme requires the student to consistently enact her ability to weaken semantic gravity, to integrate her basic knowledge and put it to work in multiple contexts. However it appears, as previously discussed, that the

[82] Groote Schuur Hospital

epistemic message insofar anatomy and physiology is relatively weakly framed, and that students are not finding it easy to integrate basic learning into higher order cognition such as motor-sensory assessments. This academic expressed 'the expectation that the student will integrate it themselves' yet at the same time acknowledging that the purpose of human biology basics is particularly unclear to students:

> …in second year we have students who are still very frustrated. So that disconnect between what does this mean for OT and being very happy with their performance in HUB but not quite getting the link between … not just OT but also clinical science … is problematic.

There appears to be some dissonance between expectations that the students be adroit at transcending contexts, and the pedagogic or curricular structures that are in place. As shown in the following excerpt 'a framework' is given and students do not have to work it out for themselves:

> And we give them the theory that gives them a picture of … that gives them a framework to … ask the right questions and choose the right kinds of assessments.

According to a professional perspective, the ideal occupational therapy student is considered to be proficient at integrating basic knowledge into a socialised form where 'humanity' (Ella) is served. However, there seems to be uncertainty at programme level about exactly what constitutes the necessary basic physiology and anatomy for occupational therapists.

Comparing and contrasting the two programmes' dominant codes as evidenced in interview data, physiotherapy's elite code has far stronger underlying epistemic relations than does occupational therapy. Physiotherapy's dominant code and its epistemic message are clearly signalled as are specificities about the disciplinary knowledge base; physiotherapy practices are imbued with weak semantic gravity. That success requires the ability to weaken semantic gravity is announced unambiguously in the departmental message. Occupational therapy's elite code is underpinned with its social relations more dominant than epistemic relations; the epistemic message is not clearly signalled to students, and neither are the fundamental knowledges. There exists

a requirement that the student finds her own way of weakening semantic gravity and transcending context, while the disciplinary context of the knowledge base is vague and unpronounced.

6.4 Professional perspectives of the clinical arena: identifying what fundamental knowledge is missing and possible implications

> …physios are more clinical than OTs … they're more medical than OTs. OTs straddle the medical sciences and the social sciences. We don't have the tools to assess clinical conditions. It's not our focus (…)
>
> It's a different profession (…) our basics aren't their basics. (Ella)

Developing practice knowledge is acknowledged as a complex process which is difficult to teach. Rowe et al (2012, p216) noted that even though students are exposed during their clinical education to situated learning, they also need 'epistemological access to tacit knowledge and clinical reasoning skills' so that they learn how to interpret clinical problems.

Occupational therapy and physiotherapy clinical educators (Ella and René respectively) provide insights into the impacts when there are gaps in necessary knowledge, and also the consequences in the clinical arena when the basic curriculum does not provide the foundation for cumulative integrative learning.

Ella talked about final year students who could not 'assess properly' and she expressed that certain epistemic requisites were missing – gaps in knowledge:

> But we would have a student who would not have understood the basics about joints, different kinds of joints.
>
> (…) students who may be too concerned about the structure and not so much about what the dysfunction of that body structure means in the big scheme of things ...

Ella's remarks convey that students of OT in their final year are still grappling with being able to assess clients. This reflects students' challenges with integrating knowledge to

apply in different contexts and practices, and it possibly also reflects that the basic knowledge foundation has not been laid. The academic's contention is that the student may not have learned the basics about joints - how they are structured and how they work. The possibility also exists that this basic anatomy may not have been taught, or that it may not have been organised or learned in a way which facilitates integration of knowledge into professional contexts. At the same time a concern is expressed about students being too concerned with structure (anatomy) and not being able to extrapolate this knowledge to structural dysfunction (by weakening SG) and then making meaning of an even more abstracted realm 'the big scheme of things' (SG-).

I asked what the implications would be for the occupational therapy professional if there were an imbalance in the proportionality of the basic disciplines comprising human biology:

> … in terms of … of content of physiology, I don't have concerns around a particular heaviness towards anatomy given the nature of our work.
>
> … where I would want to see further work is in relation to clinical sciences. Clinical sciences is in crisis. (…) It's not working at all and it concerns me greatly. (…) for me the … the content that may still be missing which I might not be conversant with, with regards to physiology, should be what would strengthen clinical science. But if clinical sciences is poor, it's difficult then to say – to see incidentally is it a clinical science issue or is a basic issue. So I think that's - that should be continuous work. (…) Because if students won't understand hypertension because the basics are missing, I'd have a problem. If students won't understand TB because the basics are missing, I'd have a problem.

These perceptions convey firstly a fundamental difference between the professions: physiotherapy is explicitly based on physiology for assessing, diagnosing and treatment of patients; occupational therapy as represented by Ella depends more on anatomy in the 'nature of [OT] work'. From the description given, Ella is somewhat unsure or not entirely 'conversant with' the fundamental role of physiology for the profession and

demonstrates a fair amount of conjecture that physiology's role is to underpin the clinical sciences. However (and here I use professional rationality as a physiologist) in order that the student understands 'hypertension' there needs to be an understanding of normal cardiorespiratory functioning (physiology of systems), and in order to better understand 'TB' the basics of immunology are required, so from the occupational therapy side this seems to identify some missing *basic* knowledge. (I follow up with these points in Chapter 7 when analysing the fundamental curriculum) There is another point that is raised when Ella talks about 'continuous work' which I understand her to mean collaborative engagement in curriculum planning.

Ella also indicated how some students have come to expect that there are guidelines or 'frameworks' or 'recipes' on how to reason and do client assessment, and how to transfer learning across multiple contexts. And she queried if students were guided by physiology and anatomy lecturers on how to integrate or link concepts:

> I had a student who graduated (...) who came to see me with concerns ... so basically she (...) felt that we did not give enough ... recipes. We didn't give enough of – this is! [interviewee's emphasis].
>
> ... what I'm asking is would there be for instance an introduction about movement before anything starts and then there's you know a guide – a guide – a mind map – or a guidance to students on – so when we talk about movement it relies on this and that and you get this from you know physiology lecturers and this from anatomy lecturers and then we'll have a consolidation...

There seem to be some student expectations of being given frameworks and guidelines on how to reason, and link and integrate, and the OT programme appears to be in support of this approach.

Acknowledging that the professions have different basic requirements of human biology, I now turn to physiotherapy's understanding of what may be missing from the foundational curriculum:

… included in neuro physiology are pain processes …we are front line practitioners ninety percent of our patients come to us because of pain. Physiology underpinning pain, I've - I'm teaching from scratch in third year because it's missing …

René: Movement Science… We are forever going through the phases of inflammation and healing. We are continually emphasising to them okay, so if this is the condition. Where are we? At a cellular level, what is happening? stages of healing? (…) If we are six weeks post injury, whether it's a bone or a muscle or a tendon where are we in terms of tissue healing? How much resistance can we give if we're rehabilitating this patient? How much weight can this patient put on this leg? Do they still need to be on crutches? So if they're – if there's – if immunology is the kind of the box that their knowledge comes in and they're not getting it, we have a problem...

G: So that would speak to a huge gap – in the course?

René: Big gap. Which is currently being picked up. (…) But my concern is that they're exposed to it at a level where we're expecting and basic underpinning knowledge that isn't there.

And immunology – I mean what else would be incredibly important for all the cardio respiratory conditions…

When we look at the prevalence of muscle skeletal conditions the physiotherapist see, the most prevalent conditions that we get referred, lumbar spine. (…) We need to make sure that the curriculum addresses the spine with as much detail as the upper limbs[83].

There are very specific knowledge areas that have been identified as essential to the physiotherapy professional, and which appear not to be part of fundamental teaching in the Human Biology course: neurophysiology with special attention to pain; tissue damage, inflammation and healing (immunology); and cardiorespiratory conditions. For

[83] Lumbar spine is afforded five lectures; upper limb is afforded half a semester.

anatomy, there seems to be under-emphasis on topics which hold most relevance for the profession such as lumbar spine.

From the professional perspective there were concerns expressed about establishing fundamentals:

> What I feel is not working is that the depth is insufficient it's kind of a pretty global, so general thing. (...) I just feel that the message that comes through in the delivery of the course is that this course is just a course that has to be done and passed. ...'oh just learn this, that's all you need to pass the test'... and it's not delivered with an understanding that this course is fundamental to the profession.
>
> And in years 3 and 4 for example, I might give them a lecture on managing whiplash. And I – in preparation for that lecture will tell them, go back and review your lecture notes from HUB on structure of the neck and muscle physiology and tissue damage for example. So they need to have that knowledge in order to progress further. Because later in the curriculum we don't have time to reteach it (...)

This reflection suggests that generalisation of the course has come at the expense of necessary depth of coverage. There is also the perception that the message emanating from the Human Biology course neglects to conceive of, and convey to students of the profession (physiotherapy by this account) the fundamental nature of the biomedical sciences.

The following professional insights indicate the implication of not only knowledge gaps, but also the implication if cumulative, integrative learning does not happen. There can be serious consequences if the knowledge base is weak, and if students have not acquired skills to put knowledge to work in clinical contexts. These together could contribute to underdeveloped rationalisation and clinical assessment (command over weakening and strengthening semantic gravity) which ultimately may lead to inept treatment and possible harm to a patient:

> You know, I expect them to have that kind of start knowledge to understand so as a physiotherapist I need to be looking at: I'm in an inflammatory stage, what anti-inflammatory modalities do I have, what would be appropriate here as I transition, it's the next stage of healing. Now I can introduce heat, it's not contra indicated. It is contra indicated in the first stage. You know, so having that understanding to integrate their reasoning later.

It is clear how processes build cumulatively, how conceptual understanding integrates previous learning. The example also demonstrates how essential it is for the student-knower to integrate and make-meaning of a staged and sequential process such as healing. Every clinical stage will require the student to recontextualise their understanding by weakening semantic gravity. René as an experienced clinical educator of many years standing, expressed her experiences of student performance in the clinical arena where integration of knowledge, reasoning, interpretation and problem-solving underpin assessment, diagnosis and treatment:

> … missing in this generation…they're frightened (…) but for me that's a reflection of confidence of they're terrified of being wrong. They're – and they're terrified of working out for themselves because what if I haven't got 100% right (…) they just want to be told the answer. Just tell me what I should do. Just tell me what to do.

> So maybe it's linked with (…) the problem solving and the willingness to problem solve, the willingness to make a plan and work it out somewhere. If that's difficult it requires a lot of mentoring, a lot of facilitation in their third and fourth years…

> And for me one of the things in their final year is that it's underpinned because they're not secure in their basic knowledge. They don't trust their basic knowledge.

I would like the reader to recall the OT educator's account of students, similarly asking for more 'recipes' and prescriptions on what to do, and their struggling with assessment even as a final year student. At the same time the lecturer remarked that students were struggling with the basics of how joints work. The concerns raised by both practitioners refer that all is not well in clinical practices and that students appear to be struggling with integrating physiological and anatomical fundamentals into professional contexts. Gaps in basic knowledge have been identified, and there appear to be concerns how knowledge is brought forward for application in practice contexts. This leads to the next chapter where I analyse the foundational course of Human Biology.

6.5 Concluding remarks

An elite code underpins physiotherapy. The basis of legitimacy is made apparent by the manner in which the programme and the physiotherapy profession are projected in relevant faculty documents. Strong epistemic relations emphasise how physiotherapy treatment modalities have a physiological basis. Social relations specialising the profession are also strong. An equally important message arising from this is that integrative, cumulative learning is required for competent clinical performance. Proper assessment, diagnosis and treatment require a sophisticated ability to integrate meanings, by weakening and strengthening semantic gravity. The basis of legitimacy can be considered as a rhizomatic code (SG-/SD+).

A senior physiotherapy educator reported concerns about knowledge gaps, and students' nonchalant attitude to problem-solving and putting knowledge to work. There was also a sense that many students struggle with reasoning and assessments, and integrating basic knowledge into clinical practices and contexts. There appears to be forms of code clash with what is required by the advanced studies component of the Physiotherapy programme, and the profession (elite code, rhizomatic code), and the code that some students coming in to the clinical environment bring with them.

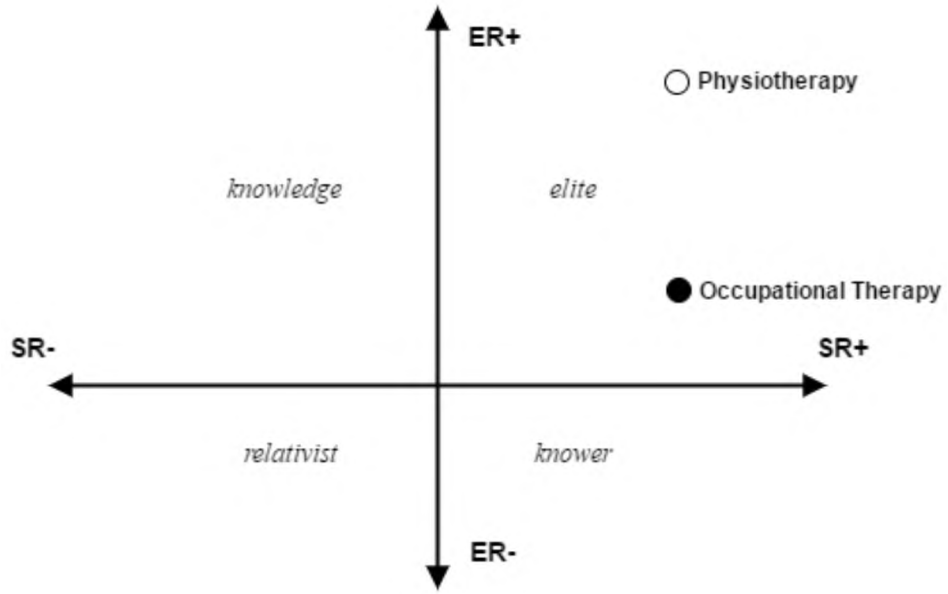

Figure 6.4. Physiotherapy (PT) elite code is specialised by particularly strong ER in contrast to the elite code of Occupational Therapy (OT) where SR is emphasised more strongly than ER.

Occupational therapy has an elite code which is underpinned by stronger SR and relatively weak ER. In documentary evidence as well as that emanating from interview, the epistemic relations are downplayed and not obvious to the student. Data suggest the profession and its students should be guided by humanistic intentions. In assessment of clients to determine their fitness for work, the senior clinical educator remarked that advanced occupational therapy students struggle to transfer basic knowledge into workplace contexts. Several students are finding it difficult to weaken semantic gravity and move along the SG wave as required in the clinical context. Semantic density (SD) in occupational therapy is weaker than physiotherapy. The semantic code could not easily be derived by analyses of documents and interview. Some concerns were voiced of students not having been taught, or students not having understood, the basics about joints – which according to the professional representative is essential anatomical knowledge.

The bases of the professions are different as is their focus; consequently the respective professional training programmes have differential requirements of fundamental knowledge. The foundational curriculum, its organising principles, relations to the disciplines and relatedness to the rehabilitative professions is considered in the next chapter.

CHAPTER 7. MAPPING THE DISCIPLINES IN THE FOUNDATIONAL CURRICULUM

7.1 Introduction

In this chapter I report on the disciplines, physiology and anatomy, and the nature of their positions in the traditional foundational curriculum before a merger. I then discuss the extent to which the envisaged disciplinary integration has been enacted and how it is framed for the rehabilitation health professions of Physiotherapy (PT) and Occupational Therapy (OT). Data were obtained from course outlines published for students and staff in Faculty of Health Sciences handbooks (1994 – 2013), and from lecture schedules (obtained from the departmental repository) for the enacted curriculum. Next I characterise the extent and nature of integration practices from the perspective of two staff members who taught components of physiology and components of anatomy in the human biology basic curriculum.

I use the LCT Specialisation and LCT Semantics to reveal the organising principles of practices, contexts and dispositions.

7.2 Disciplinarity to interdisciplinarity in the foundational curriculum for OT/PT

At this university, anatomy and physiology have always been foundational or service courses to medicine and allied professions. Before the merger, when the disciplines were more clearly classified, curricular disciplinary decisions resided in the respective departments. As service courses for physiotherapy and occupational therapy there were presumably discussions between the relevant science and professional departments as to basic content required in the curriculum. In the current post-merger programme where the concept of integration is valued, I explore the positioning of the disciplines in curriculum, and I explore their fundamental positioning and role in respect of the professions. I analyse where power and control is vested, what the specialising and semantic principles are of the disciplines, and explore what is legitimated as fundamental to each profession.

7.2.1 Anatomy's disciplinary position in the curriculum before integration

Between 1994 and 1998 there was an anatomy first year half course (ANT 104s) for medical, physiotherapy and occupational therapy students. The course envisaged introducing the student to 'fundamentals' of cell biology, histology, embryology and morphological anatomy of body systems and thereby to serve as 'the foundation for more detailed regional microscopic and macroscopic anatomy in the 2nd year of study' (FHB[84]1994-98). The course was terminated at the end of 1998.

Course data from faculty handbooks show that from 1994 there were two second year anatomy courses running in parallel: Anatomy (ANT208W) for physiotherapy students and medical students together, and Anatomy (ANT207W) for occupational therapy students (and possibly nurses though I could not verify this). Both anatomy courses described their content as follows:

> Includes all aspects of gross anatomy (with special emphasis on musculo-skeletal systems), neuro-anatomy and selected topics in applied anatomy and histology. Full course of lectures, tutorials and practicals extending over a whole year. (FHB1994-03 except that histology was excluded for OT's from 1999)

The disciplinary context specifies gross anatomy. However there is some confusion in the message by first claiming 'all aspects' then declaring a 'special emphasis on musculo-skeletal' and identifying 'neuro-anatomy'. The epistemic emphasis or boundaries seem to shift from 'all aspects of gross anatomy' to 'selected topics in applied anatomy' and 'histology' and while this possibly suggests weaker classification and framing of epistemic relations, it also signals an implicit requirement that the student needed to differentially contextualise knowledge in the macro or gross environment, and in the microscopic anatomy or 'histology environment'. A form of hierarchical knowledge structuring is imaginable if one considers microscopic anatomy (histology) integrated into the course of gross anatomy (structures visible with naked eye). The student needed an ability to weaken semantic gravity and apply propositional knowledge across

[84] Faculty handbook is abbreviated to FHB followed by the relevant year(s). The twenty year study period was 1994 until and including 2013.

contexts (SG-). Because concepts appear a bit muddled in the course description, I haven't determined semantic density from these sources.

In 1999 there was a change in ANT207W which became known as Anatomy for OT and at the same time histology (micro-anatomy) was removed from the course description. This signalled a weakening of epistemic relations relative to the Physiotherapy Anatomy course. Verticality or hierarchy was not apparent. Learning was focussed on gross anatomical structures, and no longer complemented by an understanding of tissue micro-structure. This made learning more context-dependent and semantic gravity was considerably strengthened (SG+).

The course code changed to HUB in both anatomy courses in 2001 prior to the course merging with physiology a couple of years later. The second year Anatomy course for Physiotherapy was specialised by stronger ER and SR in the knowledge code than was the case for occupational therapy. Anatomy for OT was more context-dependent (stronger SG) than Anatomy for PT.

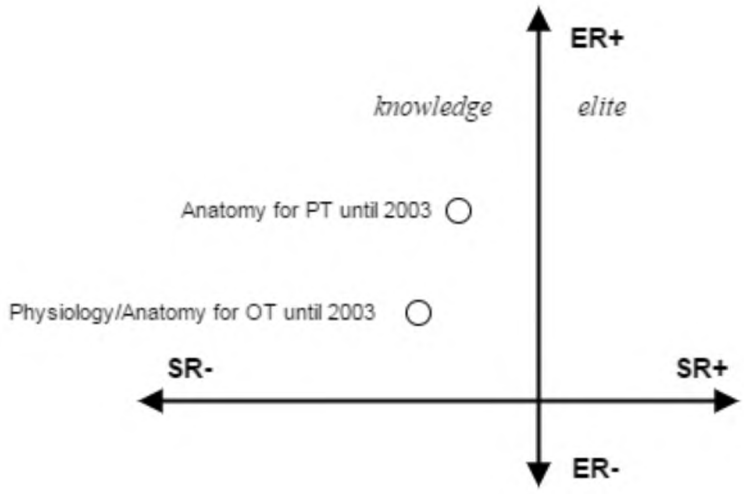

Figure 7.1 Relative strength of epistemic relations in Anatomy for PT and OT before integration to HUB and integration of student cohorts.

7.2.2 Physiology's disciplinary position in the curriculum before integration

Physiology has traditionally been a senior second year course and it was not offered at first year level until 2003 when the human biology course 'Anatomy and Physiology for HRS (HUB105W)' (FHB2003, p127) came into being. This narrative uses course data from

faculty handbooks to profile the principles underpinning the second year physiology curriculum for rehabilitative health professionals prior to this integration. Physiotherapy and occupational therapy students were taught in separate streams.

Physiology for the OT (PGY203W) conveys in faculty handbooks, a non-specific message:

> This is a second year course in the B. Nursing and BSc Occupational Therapy degree curricula. Systematic lectures and tutorials on the functions of tissues and organs of the human body. (FHB1994-03 with modification of cohorts)

Students of nursing, dietetics and pharmacology were grouped together for this course at various times between 1994 and 2003 (FHB1994-03). Evaluation was by class tests, tutorials and one final theory exam that counted 55% of the record. Framing and classification not only of the discipline but also the cohorts of students appears to be weak. 'Systematic lectures' does not make clear to students the hierarchical nature of physiology since no basis or starting point is announced. The course is outlined in generalised, non-specific terms, conveying weak epistemic relations. The absence of a laboratory component announces yet weaker ER, and also sends a message that the student's social relation to the discipline was as learner of propositional knowledge rather than needing an aptitude for experimental, more procedural knowing. Learning appears in the most part to have been context-dependent, indicating stronger semantic gravity (SG+). The term 'functions' is intuitively condensed with many meanings, yet it is not expanded in the course descriptor which instead conveys weaker semantic density. Overall the Physiology course for Occupational Therapy was, using faculty course data, relatively weakly specialised by its epistemic relations and social relations. The ER is dominant however and the organising principles indicate a knowledge code (ER+/SR-) mapped low on the epistemic axis. More context dependent (SG+) learning underpins Physiology for the OT.

Between 1994 and 2004 (integration into Human Biology) there were two iterations of the Physiology course for Physiotherapy students. In the first iteration, which lasted until 2000, Physiology (PGY202W) was described as:

> A senior full course and general course in physiology. It contains systematic lectures on function of mammalian tissues and organs. There are practicals to demonstrate basic principles in physiology. (FHB1994-99)

Physiology's identity and characterisation as a 'senior course' is clearly expressed (FHB1994-99). The announcement that laboratory sessions enabled the demonstration of 'basic principles in physiology' indicated the hierarchical or vertical nature of the discipline and at the same time sent a message that fundamental principles needed to be acquired by the student in order to make meaning of physiology. There is a recognised nexus between laboratory-based and classroom-based teaching which is reflected also in the marks record: 'class tests 25%, practicals 17%, 2x theory exams 50%, and practical exam 8%' (FHB1994-99). The student is expected to transfer learning from the books (theory) to the bench (practical) and vice versa, shuttling between procedural know how (KH) based on 'principles' and conceptual knowledge. Learning was thus not strongly bound to context, and semantic gravity can be regarded as weak (SG-). The epistemic relations that underpin practices were reasonably strongly prescribed, and the student was expected to relate both as a propositional learner, and as an applied, procedural scientist kind of knower, thus relatively strong social relations. The basis of distinction may be regarded as a knowledge code with stronger emphasised ER, and the measure of achievement weak semantic gravity (SG-) enabling learning to be applied in different contexts

Between 2000 and 2003 the second year course of Physiology for Physiotherapists was split across semesters: 'Maintenance of homeostasis' (PGY210F) in semester one and 'Physiology of organ systems' (PGY211S) in semester two (FHB2000-03):

> PGY210F: This is a senior half course, second year. This course contains lectures on the physiology of body fluids and excitable tissues and of the two main systems (nervous and endocrine) which regulate and integrate organ and cell function. Practical classes demonstrate basic physiological principles relating to cardiac and skeletal muscle function and to the estimation of volumes of body fluid compartments.

> PGY211S: This course contains lectures on the physiology of organ systems (including alimentary, circulatory, respiratory, excretory systems) and on metabolism. Practical classes demonstrate basic principles of membrane physiology and electrocardiography and of methods for the isolation & characterisation of electrophysiological signals.

In this period, data indicate considerable strengthening of epistemic relations. Epistemic stipulations are 'body fluids', 'excitable tissues' (nerves and muscles), the nervous system, endocrine system and various other organ systems. Physiology (as explained in Chapter 2) is distinguished as combined knowledge of biophysics, biochemistry and biomolecules – all are complex entities and learning is enhanced by demonstration in the laboratory thus making the practical session an essential pedagogical space. The strongly framed epistemics of the practical sessions in the course descriptions included 'cardiac and skeletal muscle function', electrophysiology and nerve function, and 'electrocardiography' (ECG). Relevance to physiotherapy which uses electrotherapeutic and interferential treatment modalities (Physiotherapy Programme as per FHB1994-2013 and Chapter 6) was therefore explicitly signalled to incoming students. Social relations are stronger emphasised by specifying practical content since the student will need also to identify as one who has aptitude for, or cultivates a gaze as, a chemist or physicist to 'estimat(e) volumes of body fluids', characterise 'electrophysiological signals' understand principles of 'electrocardiography'. Strongly emphasised ER and stronger SR specialise the Physiology course for Physiotherapists – as an elite code (ER+/SR+).

The strongly hierarchical nature of the discipline where knowledge builds by integrating prior learned 'basic physiological principles' (FHB2000-03) is accentuated. For epistemic ascent (Winch 2013, 2014) the physiology student is required to navigate the complexities of conceptual, theoretical knowledge as well as laboratory-based, practical and procedural knowledge. The successful student needs to put knowledge to work in diverse contexts and in the process there are knowledge transformations and recontextualisations (Evans et al 2010). Processes 'regulate and integrate … organ and cell function' and this indicates that propositions are in themselves integrative, and that there are different stages of meaning-making at, for example, cellular, organ, and

systems levels. The structuring of physiology requires a sophisticated ability of the student to transfer learning and weaken semantic gravity (SG-) according to the different practices and complexities of context. Similarly, Georgiou (2016) found semantic gravity to be an organising principle of physics as a knowledge structure.

Moving to semantic density (SD) and the extent of condensation of meaning within a term or practice, I use 'homeostasis' which is prescribed as the focus of first semester. There are a constellation of meanings condensed in the concept of homeostasis – conferring an emphatic and strong semantic density (SD+). For example homeostasis is about the regulation of all bodily functions at a cellular, organ and systemic level, and further to that homeostasis involves the regulation of fluids, tissues and biochemicals. Another example of high condensation of meanings (SD+) is the term 'function': the course outline speaks to cellular function, specialised cell function ('skeletal muscle'), organ function ('cardiac'), and function of systems ('nervous and endocrine'). In a similar way, for semester 2, 'system' concentrates or condenses an almost infinite number of concepts, thus indicating strong semantic density (SD+). The status of the Physiology course at this time was characterised by (SG-/SD+) or a rhizomatic code.

In 2001 the course codes changed to HUB (human biology) a few years before the actual course merger: 'Physiology: maintenance of homeostasis (HUB214F) / Physiology of organ systems (HUB213S)' (FHB2001, p90). However there were no further changes to the course until integration with anatomy in 2004.

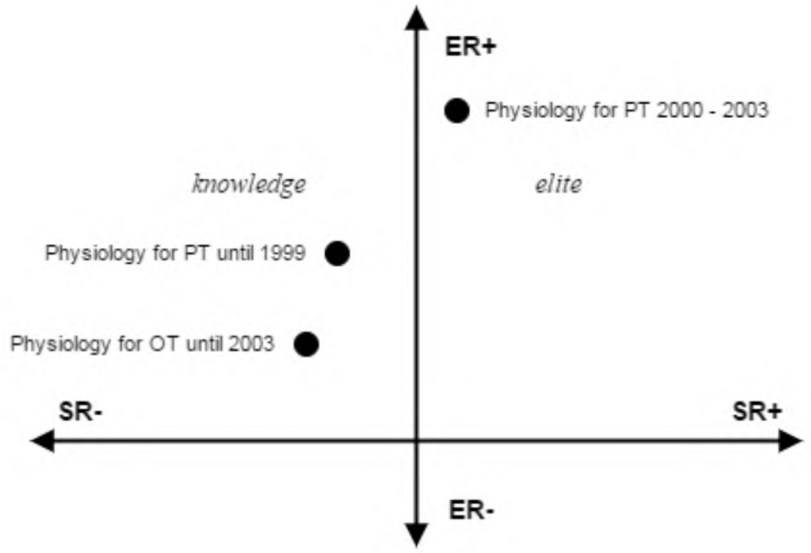

Figure 7.2. Relative strength of epistemic relations in Physiology for PT and for OT before integration to HUB and integration of student cohorts.

In summarising this period of analysis, physiotherapists and occupational therapists followed separate anatomy and physiology courses which were differentially specialised:

Anatomy was found to be underpinned by a knowledge code. For the physiotherapists' course however epistemic relations were more strongly emphasised on account of the histology (micro-anatomy) component, and social relations strengthened in tandem. This microscopic dimension also contributed to a more hierarchical structuring of knowledge for the physiotherapy student, and consequently weaker semantic gravity organised practices and contexts. The courses remained stable and unchanged until the merger.

Physiology for occupational therapists was underpinned by a knowledge code where both epistemic and social specialisations were weakly emphasised. There was no practical or laboratory component and principles of semantic gravity did not especially characterise the course structure. Learning was more strongly bound to context of acquisition (SG+). Physiology for the physiotherapist was more strongly classified and self-identified as a senior course. A hierarchical knowledge structure established on 'basic principles' was clearly announced and though not definitive this gives some indication that there may have been sequential organisation to facilitate cumulative learning (Maton 2009, 2014, Muller 2009, 2013, 2015). In 2000 the senior course was restructured and semesterised and physiology practices and contexts were more

precisely characterised. In the process relevance to the physiotherapy profession became more pronounced. The laboratory, or the practical session, was further emphasised as essential to learning the basic principles of physiology and there were also certain epistemic stipulations indicating fundamental relatedness to the physiotherapy profession. Physiology for physiotherapy students became specialised by especially strong ER yet also stronger SR and the knowledge code shifted towards elite coding (ER+SR+). This more explicitly aligned or matched with physiotherapy's elite code (Chapter 6). A further characterisation of the course (2000 – 2003) was its SG-/SD+ organising principles – a rhizomatic code.

7.2.3 Integration of Physiology and Anatomy: the organising principles of the Human Biology curriculum

Muller (2015) reminds us that each discipline (or its curricular subject) through their different epistemic and social properties bring different logics for coherence and sequencing to curriculum planning which has implications when two subjects are brought together into a merged whole. Physiology and anatomy merged into a new foundational 'programme' in a staged process (2003-2004). This section maps integration of the disciplines from that point until 2013 which signalled the end of my study. The foundational biomedical sciences had been dedicated separately to physiotherapists and occupational therapists on account of the professions having different requirements of the basics or fundamentals (also refer Chapter 6). After constitution of Human Biology, these students for the first time entered the same classroom and the same course. Class size was considerably expanded. The Human Biology programme extended over two years and I analyse years one and two separately.

<u>Year 1: Anatomy and Physiology 1 for HRS</u>

Anatomy at one stage had been a half course at first year level for physiotherapists and medical students (terminated in 1998). Physiology however was introduced at first year level for the first time as part of the Human Biology course 'Anatomy and Physiology for HRS (HUB105W)':

> This year long course forms the first half of two-year programme covering aspects of human anatomy and general physiology. Special emphasis is placed on those aspects related to clinical practice of physiotherapy and OT. (FHB2003, p127)

The message conveys the intention to have an integrative two year programme where the 'first half' gels with the 'second half'. The intention to create a fundamental basic sciences platform for the clinical practices of both professions is asserted. Nevertheless the precise role that each discipline was expected to contribute to the basis for 'clinical practice' is not clearly articulated.

The programme covers aspects of anatomy and 'general' physiology – a generalisation without clear delimitations which suggests weaker framing and classification of each disciplinary domain. In this respect epistemic relations are weaker. There is some strengthening of ER of the interdisciplinary entity when it is emphasised that the disciplines together are envisaged to have relatedness to clinical practice and procedures. The envisaged linkage of knowledge from year one 'the first half' to year two to clinical practice espouses a valuing of cumulative, integrative knowledge-building and assumes the maturing student will have developed the skills to put knowledge to work in clinical contexts. The need to integrate knowledge and recontextualise is not obviously messaged to students, although weak semantic gravity is envisaged as an organising principle of the new course.

Teaching modalities are mentioned as 'lectures, tutorials and practicals' (FHB2003, p127). In enactment 'practicals' meant working with cadavers only (gross anatomy) and physiotherapy lost the histology component. In the process anatomical meaning-making or learning was more strongly bound to context and semantic gravity strengthened SG+. In the merged cohort the relatively weaker semantic gravity (SG-) which had previously characterised Anatomy for PT shifted to a stronger SG more aligned with OT.

Relinquishing the laboratory as a pedagogical arena was a pivotal event in physiology teaching and learning. The new programme envisaged that physiology could utilise tutorials to augment pedagogy in the classroom. The hierarchical knowledge structure lost much of its shape and 'basic principles' formerly established in laboratory learning

were absented. The weak semantic gravity which had previously organised the complex practices and contexts of the physiology course for physiotherapists strengthened considerably (SG+) and was now more matched or aligned with OT. The ability to weaken semantic gravity and recontextualise or transfer knowledge to various professional practices (e.g. assessment, diagnosis, treatment) strongly defines the physiotherapy profession (Chapter 6). Weaker SG is also associated with cumulative learning and opportunity for this kind of integrative learning of physiology fundamentals was considerably lessened for the physiotherapy student, but not so for the OT.

With physiology relinquishing the laboratory as a basis of distinction and specialisation, its positioning and status also altered. As a result the disciplinary core became less visible. The elite code specialised especially by strong ER which characterised Physiology for Physiotherapists before the merger to HUB, shifted once more. Physiology in the new course was specialised by a knowledge code with considerably weaker ER and SR reducing its fundamental underpinning of physiotherapy and positioning it more in alignment with occupational therapy.

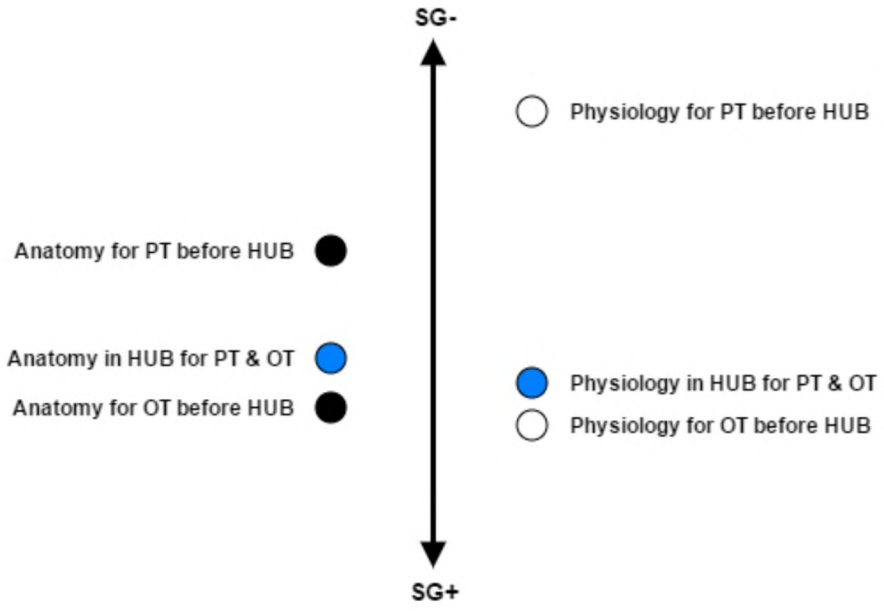

Figure 7.3. Anatomy and Physiology practices and contexts for PT and OT mapped to the SG continuum pre-merger and post-merger. (left hemisphere is Anatomy; right is Physiology)

In 2005 it seems there was an attempt at strengthening classification and epistemic relations of the disciplines by more clearly distinguishing disciplinary topics:

> This full course includes the following aspects of human anatomy and general physiology: limb and back anatomy, anatomy and physiology of cardiorespiratory system and exercise physiology. (FHB2005, p160)

There was introduction of 'exercise physiology'[85] and limb anatomy was specified while simultaneously and somewhat at odds calling for integrated anatomy and physiology (of cardiorespiratory system). A modular approach based on body systems[86] would appear to emerge with the initial emphasis on the 'cardiorespiratory system'.

There were four lectures per week (a total of 100 lectures per year) as well as one (anatomy) practical and one (physiology) tutorial fortnightly (FHB2005-07) further reducing student contact time outside of lectures. Anatomy maintained its increased exposure and positioning with students. Course convenorship was taken on by an anatomist.

In 2006 the convenorship of the course was split between an anatomist and a physiologist, both of whom were longstanding disciplinary staff from the respective departments pre-dating the merger. They also co-convened the second year course in efforts to find a balance between the disciplines and for continuities between first and second year. Back anatomy was removed from the content possibly to equalise the apportioning of lecture slots between anatomy and physiology. In 2008 it was stated in the handbook that lectures would increase from four to five per week, which may have been a measure to cope with workload, although that is speculative on my part.

Significant changes were initiated in 2009 when the whole year course became semesterised half courses. Lecture slots were reduced to four per week. The course became 'Anatomy & Physiology 1A and Anatomy & Physiology 1B' (HUB1019F/HUB1020S) with an explicitly stated aim 'to integrate anatomical and physiological knowledge in order to understand the human body as a complete organism' (FHB2009, p94) whereby physiotherapists and occupational therapists could draw on anatomical and physiological knowledge in a coherent way:

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[85] I refer the reader to Chapter 2 where I discussed how the departmental merger occurred in the absence of leadership from Physiology, and Physiology's position was instead represented by the Head of Division of Exercise Science.

[86] The MBChB PBL curriculum at the university adopted a systems-based approach in 2002 (Seggie 2010).

> HUB1019F: … includes an introduction to anatomy and the structure of the upper and lower limb. It also includes an introduction to the cellular basis of physiology, tissue and body systems, with the emphasis on nerve, muscle and body fluids.
>
> HUB1020S: …focusses on human body systems and includes detailed anatomy and physiology of the cardiovascular system, thorax and respiratory and immune systems. The main aim is to integrate anatomical and physiological knowledge in order to understand the human body as a complete organism. (FHB2009, p94)

In the first semester physiology was framed as the cellular basis of tissue and body systems. With distinct emphasis on nerve, muscle and body fluids, epistemic relations strengthened and physiology's character was distinguished from anatomy. Anatomy announces its epistemic specialisation as 'structure'. In semester two the integrative approach is underscored as 'detailed anatomy and physiology of the cardiovascular system, (…) and respiratory (…) systems'. Integration entails weakened boundaries between the disciplines and the epistemic specialisations become less obvious. Conceptually the sequence of integrated systems published in the course outline is interrupted by [anatomy] of the 'thorax' (FHB2009, p94) which could reflect an attempt to maintain disciplinary distinction and strengthen ER, despite the espoused integration.

Data demonstrate a weighting towards anatomy in the assignation of final course marks: physiology has only half the anatomy assessment opportunities on account of anatomy's practical tests and practical exams (FHB2009--13). By having an unbalanced contribution to the marks record, anatomy leverages control and power in the evaluative arena and this underscores Bernstein's assertion (1996, p42) that because the various arenas of the pedagogic device are 'not ideologically free' these become the sites for 'appropriation, conflict and control'. Wheelahan (2010) claimed that the principles underpinning curriculum mediate the way knowledge is classified and framed by competing perspectives about the purpose of education.

I felt the need to move beyond this analysis of course outlines in faculty books and delve deeper to reveal the principles underpinning the enacted curriculum. To do this, I

analysed published lecture schedules (from departmental archives). Having identified semesterisation as a key moment in this process, I compared disciplinary positions in the whole year and in the semesterised course.

Table 7.1. Anatomy and Physiology1 for HRS (HUB 1005W) as a full year course 2008 (co-convenorship).

HUB1005W	Lectures	Tests	Exams	Content
PHYSIOLOGY	59	1 ½	Theory papers 1+2	Introduction: cells-organs-systems → cell biology (organelles, membrane transport, DNA regulation of protein synthesis → physiology of muscle contraction + nerve conduction → body fluids blood haemostasis → function CVS →function respiratory system → immune system and inflammatory response
ANATOMY	57	1 ½		Introduction: structure → anatomy upper limb → anatomy lower limb → structure thorax → structure CVS → structure respiratory system

The course was co-convened by a senior physiologist and anatomist. Analysis of the lecture schedule shows that classroom teaching opportunities (lectures) for both disciplines were equivalent. For assessment of student knowledge, tests were organised after a physiology block, and after an anatomy block. The 2008 whole year course was in the most part still organised in blocks, and so was not integrated in the sense of being taught simultaneously. For these tests there were clear boundaries on what classified and specialised the disciplines. For example, there would be an assessment after the anatomy of upper and lower limbs, and an assessment after muscle and nerve function – cellular physiology. There were some modules where structure and function were fully integrated in systems biology, for example the alignment of anatomy and physiology lectures of the cardiovascular system and the respiratory system. The associated assessment[87] required the student to understand the knowledges as entwined and not separate. The end of year examinations were theory based papers assessing the full year's work. There was however clear demarcation between the physiology and anatomy components of the examination.

[87] In the table ½ indicates an integrated test – anatomy and physiology of systems.

As Table 7.1. indicates, the physiology content builds sequentially in complexity, for example students first learn about functionality of a single cell and progress to learn about specialised cells such as muscle and nerves in order that understanding is built for how a muscle contracts in response to a nerve impulse. The reader is alerted to the inclusion of immunology and inflammatory processes in the teaching schedule (detail available from uploaded lecture notes and examination questions in departmental archives). This module was subsequently dropped from 2009 onwards. Chapter 6 highlighted that from physiotherapy's perspective inflammation was a considerable gap in students' basic knowledge, and it also affected students' ability to conceptualise and link different stages of healing. Integrative, subsumptive, cumulative learning was therefore not possible. Ella, the occupational therapist also spoke to a gap in basic understanding of the body's immunological response to bacterial infection and she specified TB (Chapter 6).

The documentary data suggest the physiology component of the curriculum was organised on hierarchical principles where knowledge builds conceptually and integratively. This form of curricular organisation where concepts of higher order complexity subsume and build on established basic principles is necessary for epistemic ascent (Winch 2013, 2014) and for cumulative learning (Maton 2009, 2011, 2014). It is especially essential in the concept-rich, principled sciences (Blackie 2014, Muller 2009, 2014, 2015, Young 2014). A hierarchical specialisation of knowledge in the subject area of gross anatomy is not indicated in the data. It also appears that anatomy adopted a regional rather than sectional approach with coverage of limbs upper and lower and then the thoracic region.

With the 2009 semesterisation general convenorship of 'Anatomy and Physiology 1A and 1B' was designated to a senior anatomist and co-convenorship was discontinued. Lectures were again reduced from five to four per week resulting in a considerable loss of teaching time, anatomy practicals continued once per week with physiotherapy and occupational therapy assigned to separate groups. The first year curriculum took on the following form:

Table 7.2. 'Anatomy and Physiology for HRS 1A and 1B' after semesterisation (2009 onwards).

Semester 1: HUB1019F

HUB1019F	Lectures	Tests	Exams	Content
PHYSIOLOGY	23	2	1 theory exam (50:50) 1 anatomy practical exam	Cell biology → bone physiology remodelling → nerve conduction → skeletal muscle contraction / movement. Neuromuscular disorders: what can go wrong?
ANATOMY	21 ++ pracs	3		Upper limb (NOT wrist and hand)

Semester 2: HUB1020S

HUB1020S	Lectures	Tests	Exams	Content
PHYSIOLOGY	4	0	1 theory exam (physiology 15/100 marks) 1 anatomy practical exam	Respiratory physiology (no cardiovascular physiology in 2013)
ANATOMY	33 ++ pracs	4		Lower limb (22 lectures) → cardio-respiratory anatomy (11 lectures)

Semester one shows a balanced distribution of classroom teaching hours between anatomy and physiology, however the quantity of anatomy contact hours is augmented with practical or cadaver-based teaching. The sequence of lectures in the physiology block is graded in conceptual complexity: starting from functionality of a single cell and conceptually building to the functionality of specialised cells such as bone, muscle and nerve. By the end of the physiology block, concepts are ultimately integrated in order that the student understands that movement is about muscle contractions in response to nerve impulses. Physiological concepts are challenging for students and conceptually coherent organisation in curriculum is essential to enable cumulative learning (Muller 2009, 2014, 2015, Maton 2009) and in this way to facilitate access to powerful knowledge (Young 2013, 2014, Young and Muller 2010, 2013, Wheelahan 2010). A

regional approach would view the entire spine as a region while a sectional approach would address lumbar spine, thoracic spine, cervical spine as separate entities (the reader could also refer to Chapter 2 for more clarity). In semester one the regional topic (upper limb) is disrupted by non-completion of the wrist and hand. These are resumed as disjointed segments in year two (as will be demonstrated in the next section). While the theory paper is evenly split with physiology contributing half the marks and anatomy contributing half the marks, anatomy is legitimised as powerful knowledge through not only the extra teaching hours in the practical space but through the contribution of a practical test and a practical exam to the final record.

The second semester purports to 'integrate anatomical and physiological knowledge in order to understand the human body as a complete organism' however anatomy is legitimated by an overwhelming allocation of lecture slots (89%) coupled with practical teaching thus the enactment of integration is not accomplished. Anatomy has since 2009 assumed primary control over curriculum structuring. This appears to have had a considerable impact on modularisation and the kind of learning that is envisaged. The following schema contrasts lecture plans for the cardiovascular and respiratory systems in 2008 and then from 2009 onwards.

Table 7.3. Espoused integration of physiology and anatomy in a systems-based approach: Human Biology as a whole year course with co-disciplinary convenorship (HUB1005W 2008) compared to it as a semesterised course with anatomy convenorship (HUB1019/1020; 2009-2013). Cardiovascular and respiratory are the two systems covered in first year.

HUB1005W (2008)	HUB1019F/1020S (2013)
Cardiovascular system: Physiology (9 lectures) Anatomy (4 lectures)	Anatomy: respiratory system (6 lectures)
	Anatomy: cardiovascular system (2 lectures)
Respiratory system: Physiology (10 lectures) Anatomy (4 lectures)	Physiology: respiratory system (4 lectures)
	Anatomy: cardiovascular system (3 lectures)
Total: 27 lectures (19 physiology + 8 anatomy)	Total: 15 lectures (4 physiology + 11 anatomy)

The systems approach to human biology anticipates comprehensive understanding of the functionality of a particular body system. Since physiology's basis and focus is function, it is not surprising that with a functionality approach more power in the interdisciplinary structuring resided with physiology in 2008 (Table 7.3.). For the equivalent cardiovascular and respiratory systems in the curriculum 2009-2013 there is a significant reduction in extent. These changes could reflect decreased teaching hours (4 days/week) as well as the absence of physiology disciplinary co-convenorship. Anatomy now enjoys significantly more time in the curriculum and conversely physiology coverage has been significantly reduced. With such an imbalance the claim that students are being taught functionality of these systems can be brought into question. The less comprehensive teaching of cardiorespiratory systems also does not align well with the stated and desired outcomes as expressed by physiotherapists (see Chapter 6).

Analysis of data indicate that anatomy maintains strong control over the curriculum content and sequencing, and proportional representivity of the disciplines, and that the course aim of interdisciplinary integration is not achieved in year one.

Year 2: Anatomy and Physiology2 for HRS

'Anatomy and Physiology2 for HRS (HUB205W)' came into being in 2004 as a newly integrated course. Having discussed year one of the integrated course between 2004 and 2013, I now move to consider how the second year course was organised over the same period. The course has remained relatively stable with only minor alterations, its purpose outlined as follows:

> This year long course forms the 2nd half of a two year programme covering aspects of anatomy and general physiology. Special emphasis is placed on those aspects related to clinical practice of physiotherapy and occupational therapy. (FHB2004, p146)

The course claims to be building upon the first year course and claims also to relate topics to the clinical practice of physiotherapy and occupational therapy students. Course content is not specified, epistemic requisites are generalised and weakly classified as 'aspects' of anatomy and 'general' physiology. Teaching opportunities

consist of lectures, (anatomy) practicals, and tutorials. The final mark includes an end of year exam counting 60%.

In 2005, for one year only, the course outline became more explicit. Specifications detailed the anatomy topics and neurophysiology thereby strengthening disciplinary classification and their respective epistemic relations:

> This full year course forms the 2nd half of a two year programme covering aspects of anatomy and general physiology and includes anatomy of head and neck, neuroanatomy, neurophysiology and general physiology[88]. Special emphasis is placed on those aspects related to clinical practice of physiotherapy[89]. (FHB2005, p164)

The following year, 2006, there was a reversal to the original non-specialised course outline which contained generalisations and weak framing and classifications of disciplinary epistemic relations. The two course convenors (anatomist and physiologist) who administered first year also convened the second year course in efforts to synergise the courses.

While the course outline remained unchanged, generalised nonspecific and weakly classified up until the finalisation of the study period in 2013, there are some events worth mentioning. In 2008 the physiology co-convenor of years one and two left the university, and the course as well as the department lost a physiologist of considerable expertise and experience. In 2009 a new staff member, a medical research scientist, took on convenorship of 'Anatomy and Physiology 2 for HRS' (HUB2015W) guided in curriculum planning by the head of department. Taken together with the reformulating of the first year course, it was a period of considerable flux in the foundational curriculum on the whole.

[88] 'general physiology' repeated in original text.

[89] The omission of occupational therapy appears to be inadvertent, and was reinserted in subsequent editions.

Table 7.4. Anatomy and Physiology 2 for HRS (HUB2015W) in 2008.

HUB2015W	Lectures	Tests	Exams	Content
PHYSIOLOGY	~ 40	tbc	Theory papers 1+2	Digestion → metabolism → excretion (acid-base) → thermoregulation → neurophysiology (lectures by anatomist)
ANATOMY	~70 ++pracs	tbc		embryology → neuroanatomy (spine, head and neck)

Anatomy assumed a principal role in the second year course insofar as number of teaching hours and content, and at the same time physiology lost traction in the shared curriculum with a diminished number of teaching sessions. The lecture schedule demonstrated a fairly coherent sequence of functional content (physiology) from digestion through to excretion although there is arguably less coherence with the nervous system following afterwards. Furthermore, the integration of anatomy and physiology into systems-based modules as espoused by the course description seems to have had limited implementation with the two disciplines running in tandem (Table 4).

The central nervous system (CNS) was taught entirely by an anatomist, despite this field being considered by physiologists as a speciality field, and despite the Department having a well-staffed neurophysiology unit. This particular scenario exemplifies the dissolution of physiology's disciplinary boundary, the consequences of which are weakened traditional power and autonomy (Muller and Young 2014). In framing the CNS integration and absenting physiology expertise, anatomy knowledge appeared to be more overtly legitimated and physiology less so. By not using disciplinary experts (neurophysiologists) and by affording physiology less coverage and subordinating it epistemically, physiotherapist's professional knowledge was negatively impacted. I remind the reader that one of the physiotherapist's main roles is, according to René the senior academic and experienced practitioner, dealing with pain; clinical educators were finding this neurophysiology knowledge was entirely missing for students incoming to clinical studies and practice (Chapter 6). The clinical curricula (Appendix 1.1 p229) indicate the extent of neurology deemed essential in the BSc Physiotherapy.

The form of the second year curriculum (as at 2013) is shown in Table 7.5. An excerpt to demonstrate extent and sequencing more explicitly is shown in Table 7.6.

Table 7.5. Anatomy and Physiology 2 for HRS (2009-2013) where the Human Biology curriculum is espoused to be based on a systems-approach.

HUB2015W	Lectures	Tests	Exams	Content
PHYSIOLOGY	67	1	Theory exams papers 1+2 One anatomy prac exam	Metabolism → endocrine system → regulation of metabolism → reproductive physiology → nutrition → thermoregulation → acid/base balance → sports + exercise physiology → neurophysiology (15 lectures by anatomist)
ANATOMY	63 +3hr pracs/ week	2		Head +neck → hand → pelvic floor → abdominal wall →spine → neuroanatomy (29 lectures)

Table 7.6. Excerpt from HUB2015W lecture schedule 2013 as an exemplar of topics and sequence.

Physiology: Reproductive systems (6 lectures)
Anatomy: Upper limb (continued from 1st year)– wrist and hand (8 lectures)
Anatomy: Pelvic Floor (5 lectures)
Anatomy: Abdominal Wall (5 lectures)
Anatomy: Lumbar Spine (5 lectures)
Nutrition (5 lectures)

The inclusion of reproductive physiology and nutrition is unusual and the relevance for physiotherapists whose primary function is to restore physical functionality after muscle-nerve injury, and occupational therapists whose primary role is to enable client's re-integration into occupation, is unclear (further background emerged from the interview as is discussed later). The anatomy component shows little if any continuity as

indicated by an extracted sequence from the lecture schedule (Table 6): the stand-alone wrist and hand is separated from the rest of the upper limb (an anatomical region) taught in year one; this is then followed by anatomy of the pelvic floor, abdominal wall, and lumbar spine. Lumbar spine injury is one of the most prevalent clinical conditions addressed by physiotherapists (as indicated by the senior clinical educator in Chapter 6) so five lectures appears to be inadequate. Curricular organisation is segmental and strongly suggests the potential for students to view the body as compartmentalised much against the stated course aims of seeing an integrated whole. For cumulative learning to occur there is a need for coherent sequencing in curriculum (Maton 2009, Muller 2009), the structure of this course however would not seem to support this form of learning.

Anatomy and physiology are shown to run in tandem and integration does not occur. The imbalance indicated by anatomy's overall increased teaching hours (including three hours per week of practical teaching), modalities and evaluations follow on a similar pattern established in the first year course. Anatomy has more power in the curricular, teaching and evaluative spaces, and thus controls most arenas constituting the EPD (Maton 2004, 2014 and refer to Chapter 4) and anatomy knowledge is overall more strongly legitimated as the basis for success in the Human Biology course.

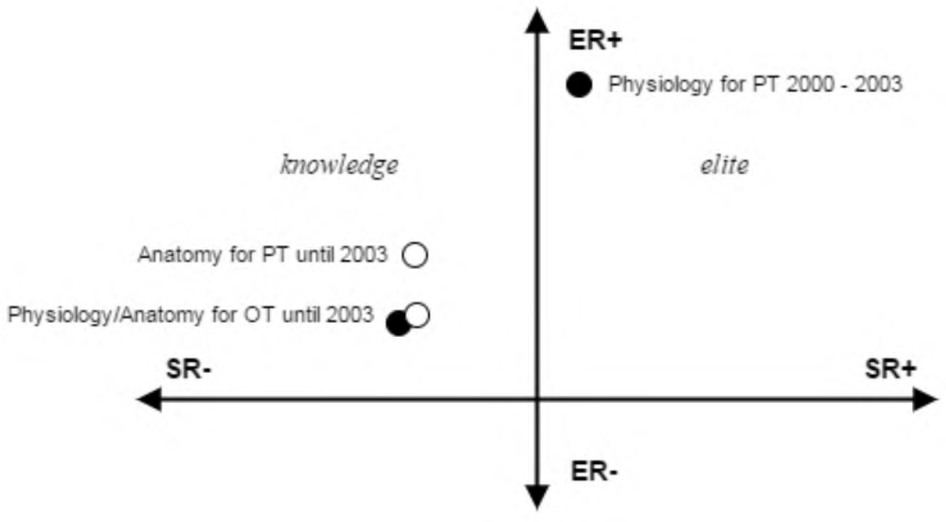

Figure 7.4. Specialisation codes underpinning Physiology for PT/OT and Anatomy for PT/OT before the merger to Human Biology.

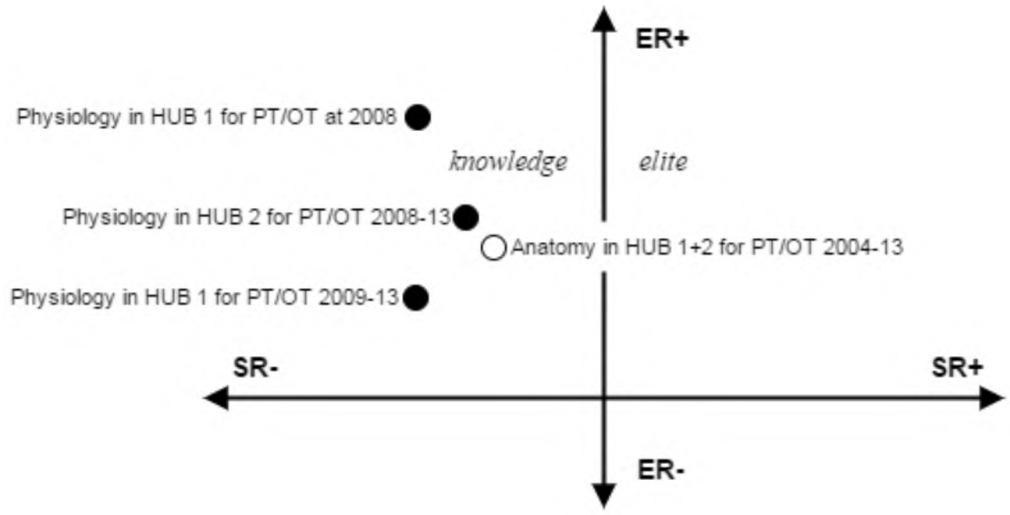

Figure 7.5. Positioning of Physiology and Anatomy in HUB course for PT/OT years 1 and 2 (after in-depth analysis of lecture schedules).

7.3 Disciplinary perspectives of integration in the Human Biology curriculum

Having discussed the biomedical curriculum and the positioning of anatomy and physiology before and after integration on the basis of curricular documentation over a period of twenty years, I now move on to analyse organisational principles of the curriculum based on the experiences of two teaching staff members who each represent a disciplinary perspective. In order to better understand how practices may be organised and structured I consider how they present various aspects of framing (as outlined in Chapter 4) and explore who makes decisions about curriculum, the selection of subject material and its extent. I consider their perspectives of how knowledge building is envisaged in each disciplinary domain and use Semantics for this analysis. Furthermore I interrogate how each disciplinary representative understood the discipline's specialised role as fundamental to the rehabilitative health professions, and how each viewed the concept of integration.

7.3.1 Organisation of anatomy practices

An in-depth interview was conducted with an anatomy lecturer who has for a number of years after the Human Biology course merger, taught modules in both the first year and

the second year course. In an attempt to protect the person's identity I use the pseudonym 'Jenna'.

Framing of curriculum decisions

Jenna was asked about her participation in curricular design or review. The question was posed to elicit the details of decision making and overall organisation of the two-year curriculum. Specifically I wanted to explore where the locus of control might exist insofar content, extent, sequence and pace.

> … as a component teacher on the anatomy course, I do not make any decisions. I simply get told you are doing six weeks of (…) and that's the basis of it. I also get given the book (…) so just see that everything within the book is covered (…) so there is in essence no guidance being given on the depth, the clarity and the amount of work that you put into it. (…) I simply get told what to teach. I've not been invited to any curriculum decision meetings simply because I teach components of the courses...
>
> Most of it is that health and rehab tells the Anatomy Department what is required for anatomy teaching at least in the way that the systems are being taught and then decisions are being made by the course convenor as to how those components are going to be divvied at what time. Often rehab needs certain things to be taught at certain times but that policy cannot always be followed because (…) I teach on other courses as well and therefore I'm only available at certain times (…) so often sometimes we are out of sync. But we try to follow because they need the basis for anatomy before they can do the applications in physiotherapy or occupational therapy continuing of where the anatomy has supposedly left off. But that in sync-ness doesn't always happen.

Although Jenna is one of the primary anatomists in the basic course, she has not participated in any curricular meetings or decision-making. She understood that the Department of Health and Rehabilitation Sciences conveys certain messages to the

'Anatomy Department' as to what anatomy teaching is required at certain times; and that the course convenor decides how anatomy components are sequenced according to various extra-curricular teaching commitments that may exist. This demonstrates strong framing of the course from a departmental perspective. It also indicates that the academic concerned has limited autonomy.

Ironically by referring to anatomy as a 'department' Jenna expresses the extent to which the two sub-sections of the new Department of Human Biology, that is Anatomy and Physiology, are still perceived as separate entities. One of the fundamentals for integration is conversations between the academics to look for synergies and to make connections for the students. However if true integration is the goal, and if key partners do not participate in shared curriculum design and regular reflection meetings then this is unlikely to occur (Mathieson 2012, Reddy 2011).

Jenna reflected on her views about how anatomy was framed in the curriculum as it was enacted in respect of sequence, content and pace:

> I've inherited a situation that was fragmented. (...).I was told to only go to a certain level and then therefore the next year we continued. And even for myself, I found this very disjointed because when I spoke to the students and I said remember we covered this last year all you sat with was 120 blank faces. And I found I had to reteach almost in essence the first part of the course to be able to continue with the second part of the course which for me is a waste of time. (...) so you not only have to remind them of old knowledge, you have to remind them of new knowledge ...
>
> ... I would only teach it if I could do the entire system within a specific year. (...) I cannot re-teach things that they were supposed to have done in first year and then continue (...) now they can see the functionality of the entire lower limb and not just portions of it. Because as I said everything is integrated. Everything works together as a system and therefore you can't have pieces of lower limb...

> It is very confusing for students I've heard complaints (…) But I said to them nothing is a stand-alone. (…) because now they come with the stand-alone hand and all of a sudden they have to learn and remember all of the other muscles that came beforehand.
>
> The muscles don't just start and end in a specific section. They cross the joints because obviously we know that as the muscle crosses a joint it moves that joint. So it has implications for the other regions.

Jenna raises concerns about a fragmented and disjointed modular component taught in sections across the two year programme. In her view this discontinuous approach confused students and interrupted their learning processes – and they were unable to make links. Chapter 6 referred to problems encountered in advanced studies where even final year occupational therapy students were reported to not know or not understand the 'basics about joints' (Ella). The OT educator spoke to gaps in knowledge; when the basics are missing it compromised students' ability to do assessments.

Muller (2011) reported that a disconnected ensemble can occur when disciplines lose their core structuring in interdisciplinary programmes. There is an apparent tension between the different approaches to the discipline itself with Jenna favouring a regional approach (Drake et al 2009, Richardson 2004) which is more systemic and layered, versus a segmental, sectional approach. The regional approach is embodied by Jenna wanting to do a whole region so students can 'more holistically' see the 'functionality of the entire' limb. She understood this to be more integrative and to give more complete meaning and better understanding to the students. The sectional approach still persists as documentary evidence shows, and this approach means for example that there would be a cluster of lectures on the ankle, at another time a few lectures on the knee, and separately some teaching on the hip joint.

> But there are preconceived ideas that come over from first semester into second semester and you almost have to re-discipline the students to come to lectures, to listen to what is going on, because they often get the impression in first semester that if they miss out the lecture, it's okay they can always catch it up by doing it on their own

> (…) They come with the preconceived notion that the lectures are going to be slow, it's going to be only at a certain pace and they will be told what to study for exams …

Framing refers to who has control over pacing, content, and sequencing in curriculum (Bernstein 2000 and refer Chapter 3). From Jenna's account about pacing, students' study instructions, and being informed to teach according to the notebooks, these all indicate that control resides with the senior academic, rather than the person teaching in the classroom. Not unsurprisingly different approaches signal different messages to students. Mathieson (2012) reminds us that 'academic teaching learning and assessment cultures embrace different values, different approaches to teaching and learning, different relationships between academics and students, and different relationships between academics engaged in and delivering curriculum.'

In response to my question about whether Physiology and Anatomy are well integrated in this curriculum, Jenna reflected on the Human Biology curriculum for years 1 and 2 as it existed in 2013. (Refer to section 7.1 of this chapter).

> No. Because if you look at that, anatomy has the overwhelming bulk of the lectures, you can understand that in a way because there's a lot of work to cover but remember anatomy is structure, physiology is function and structure and function must be fully integrated so they can understand the functionality of those various systems.
>
> You cannot teach them piecemeal and expect the students to understand what is going on in those various areas. (…) Like for example, your cardiovascular anatomy is broken up by the respiratory physiology sitting in the middle over there. It has to be taught - in a more integrated way because … structure and function cannot be separated.
>
> You can also see that less than half of the time is being spent on neurophysiology and double the time is being spent on neuro anatomy. (…) I would suggest that physiology and anatomy actually

> gets equal standing and the same amount of lectures because everything should be covered to the same degree.
>
> … and as you can also see there is quite a bit of anatomy going on over here and the … the other portions of the physiology are also now being placed in where there are in essence, gaps in anatomy so the second year is also not as well integrated. (…) And you can see that the flow of information is not as important.

How knowledge-building is envisaged in anatomy

The segmental organisation of curriculum, the realisation of different approaches within anatomy to the learning of the subject, and the overemphasis on gross anatomy in the foundational curriculum for rehabilitative professionals speaks to there being different understandings by different lecturers of how knowledge builds. Jenna's remark about 'flow of information' and her concern about the lack of coherent sequencing in the course prompted my enquiry into how she as one of two anatomists envisages knowledge-building and meaning-making for these students. I use semantic gravity not only as a concept that explains the extent of dependence on context; I also use its explanatory power for the ability to see beyond the obvious, more visible context. In the previous chapter (Chapter 6), I evaluated requirements of the professions for students' capacity to weaken semantic gravity. In this section I consider Jenna's view of the discipline of anatomy, and her intended pedagogical strategy, in terms of movements along the continuum of semantic gravity and to a limited extent, semantic density:

> …to not only have to describe muscles, but try to integrate what is now going on around. Where this is sitting, in what region is it sitting, what defines that region.

Here there is clear attempt to promote the notion of considerable weakening of semantic gravity firstly from the localised muscle to 'integrate' what is 'going on around' the particular muscle to the whole region. This process enables cumulative learning (Maton 2013). There are evidently a number of meanings condensed into the term 'region' so it can be regarded as SD+. I would need to be a classroom observer to witness

how Jenna operationalises the semantic wave (Maton 2014, Clarence 2014) in her teaching, however she seems to understand the requirements for doing so.

> … and then I also ask them to label diagrams. This is very important so that they know even though it's a 2D picture of what they're doing in 3D, it teaches them that everything has its own little region where it is going to be lying…

According to Jenna's intention the student needs to shuttle between a two dimensional image and the real life three dimensional situation. This I argue requires quite a sophisticated ability of a student to move from a flat localised context of a drawing or image to the abstracted, imaginative space of depth dimensions. With the continual cross-referencing between 2D flat and 3D depth the student is expected to rapidly weaken semantic gravity and then to strengthen SG once more, and so on which I believe requires a waveform movement on the SG continuum ending strongly SG-. The principles underpinning Jenna's envisaged teaching would promote cumulative learning and knowledge-building.

> …and what to expect when you look at a person who they will be treating and therefore know if the person is saying there's a problem in this area, you will know what is lying in that area, layered in that area and therefore what you can expect to see in that area. So in that way they're not learning only the theory, but could learn the practicalities of what's going to be happening as well.

Here Jenna explains her expectations of the clinical student, or the graduate. The context begins when they 'look at a person who they will be treating' and then they will be expected to hear what 'the person is saying (about) a problem in this area' and epistemically they'll need to move from the patient's verbal account which could be highly condensed (SD+) to their knowledge of 'what is lying in that area' and even further than that what is 'layered' in that area. This capacity to weaken gravity so considerably into the abstracted invisible sphere is demanding and is built up over time as the student matures. Jenna very evidently recognises the need to formulate a firm basis on which the student herself, through a guided process, can begin building the

skills and abilities to transfer knowledge across diverse, complex contexts. Jenna understands well the disciplinary structuring to promote cumulative learning. She seems to employ mechanisms that consistently reinforce to the students the move beyond the localised contexts, and there are apparent frequent reminders of the need for cumulative learning for the professions (Wheelahan 2010).

> I look at the muscle, the origins and insertions. I look at what they do, how they work together as a group. What type of nerve input they have. If there are problems with that nerve, what type of problems you can expect and then of course the blood supply. And of course I look at the skeletal material in very much detail (…) But you have to know what everything else is attached to and running through and what the support mechanism is in the body itself so that you know that everything works together. So that if there's a problem in the one area, it's going to have a knock-on effect for the rest of their systems going on around the skeleton.
>
> …if you lay the proper foundation, what you have to build on is that much steadier and that much all-encompassing than if you now suddenly have to start cramming in the third and the fourth year when they start going out and treating patients at the various clinics, they would either have that firm foundation they all have something good to build on. If that foundation is shaky and the anatomy is shaky then it actually has a bad reflection on you in the coming years.

Her view expresses cumulative learning as established from a basis and integrated through a student's clinical years and integrated further still when they graduate as professionals and treat patients. Jenna's understanding of what it takes for students to build knowledge cumulatively is counter to the dominant organisation of anatomy as disconnected segments in the HUB curriculum.

Anatomy as a basis of the rehabilitative health professions: a lecturer's perspective on specialisation

Jenna expressed a clear, distinct understanding of the purpose of anatomy in this course and towards the anticipated outcomes she was teaching. She talks of 'supplementing the information' and of anatomy being 'geared towards' occupation which shows that this lecturer had a clear sense of strong epistemic relations and relevance to the professions. An understanding that the professions are legitimated by strong social relations also motivates Jenna's attitude to her teaching:

> Obviously supplementing the information as I saw geared towards what their outcomes are going to be. Because I always have to remember these are physiotherapy and occupational therapy students, therefore I try to gear the anatomy of what they would be needing towards their various occupations.
>
> What I mention in my lectures is the minimum that they are needing to be able to act as professionals and get through their profession to be able to accommodate the patients that they'll be seeing one day…

She notes the distinctions between the professions; firstly by distinguishing the students separately as 'physiotherapy and occupational therapy students' and then noting 'their various occupations'. This strong classification (Bernstein 1996, 2000) is important in the context of not only a merged human biology where weakened classification is in operation but also where the class is a merger of physiotherapy and occupational therapy students who are now weakly classified as Health and Rehabs.

Although the focus for the rehabilitative professions may be different, Jenna considered the anatomy basis as similar for both cohorts of students, differing perhaps in the extent or 'depth' as she put it:

> … the physios are more hands-on than the OTs … in certain areas of the body but … because they both have to learn the same systems, not the same depth necessarily (…) outcomes might be different for each group, what they need to know as a basis for anatomy I think is the

> same (…) I try to cover as much as possible. Because even though the OTs don't need as much detail, it will benefit them in the long run to know the systems in detail because that will help them in the long run when they are setting up their own practices or when they are practising in hospitals.

Jenna considered that the physiotherapy students required more detail of functional anatomy because they are 'more hands-on than the OTs' which illustrates her understanding of the professional role of a physiotherapist. Since Jenna has not been in any meetings with the profession-specific divisions, her understanding of the physiotherapist reflects a gaze that has been cultivated through peripheral contact. As an anatomy lecturer she also recognises the intimate social relations inherent in physiotherapy where the practitioner is 'hands-on' and touches, massages and applies physical or contact therapies. An astute understanding that the professions (although the data suggests Jenna is emphasising physiotherapy more in this instance) are underpinned by both strong epistemic relations and strong social relations (ER+/SR+) – an elite code.

> … they are working with live people and not with models, that you can actually injure people if they don't know what their anatomy is all about.

Jenna's teaching is thus focussed on what she considers as relevant to the professions of physiotherapist and occupational therapist.

Summary and contestations

Data provide insights that within the anatomy disciplinary domain, there are probable contestations in respect of what is legitimated, and in how meaning and knowledge is structured. These aspects all impact on the purpose that anatomy serves as a foundation for the health professions.

A valuing of the segmental approach in the way that the curriculum is designed, and in the way anatomy is approached by some of the anatomy teachers (sectional-segmental versus regional approach), as well as the manner in which lecture slots are apportioned

according to lecturer availability has the potential to confuse the student and stunt the laying of a firm foundation in anatomy as required to become a health professional.

> Because of the way we are forced to teach, because we have to do it section by section, students get the impression that blood vessels and nerves come section by section …
>
> The muscles don't just start and end in a specific section. They cross the joints because obviously we know that as the muscle crosses a joint it moves that joint … it confuses the students.
>
> … they get the impression because there are different people that teach the different modules they get the impression that some work is optional. (…) And students – therefore students expect to be steered on what to learn. And … they have to actually learn everything (…) I give them the impression that all the work that I cover is necessary and you are going to need it. Because if you (…) if you lay the proper foundation what you have to build on is that much steadier…
>
> … what is important in anatomy and structures they have to know because they're going to be working with live people and I don't think it often pegs with them especially in first year and sometimes in second year, the importance of knowing your anatomy.

Students it would appear are getting opposing messages about what counts as important knowledge, seemingly some content is optional and they will be guided on what to study which conveys to students that there is content that it is not necessary for their professional foundation, and furthermore for their work with patients. This should alert the professions that there may be unsuitable content in the anatomy component of the human biology curriculum.

Students seem to get message that gross anatomy is about identification and memorisation:

> … because students often think that a prac test is just going to be a pin in the specimen say[ing] What is this? …

> It's not [emphasis] just about identification. Because we have to remember these are Physios and OTs. They, when they work with their patients in future, it's not just about identifying.
>
> It's also knowing what's going around those areas. As I said before, something's in one area can have implications for another area. So if they know what's going on within that area that is important. So for me the more holistic approach is actually a much and more integrated approach to teaching, is better for them because I'm looking to their future, not just the knowledge that they need to know at this point in time. So it's almost setting a platform for them to be able to build on in future and this is important for them because when they go out to clinics, they're not just looking at this as identification, but as in looking at this within this area and how is this entire area going to be affected. … so the test is not just to test knowledge but to see if they are thinking sequentially. If they are looking at this area, what is this muscle doing? How is this muscle being innervated? What is the action of this muscle? Where is it coming from? Where is it going to? Therefore what are the implications in that area?

The broader issue with achievement based on identification only, is that it keeps knowledge bound to context – strong semantic gravity (SG+). This works out to be an unsatisfactory situation for both professions as evidenced in chapter 6. There is a critical requirement for especially the physiotherapy professional who is a first-contact practitioner and who assesses, diagnoses and physically treats a client/patient to, in clinical situations, immediately have the ability to weaken, strengthen and weaken again the semantic gravity that underpins the understanding and meaning of a particular scenario. Jenna's approach to anatomy indicates a keen focus on cumulative integrative knowledge-building for clinical studies and beyond. With power vested elsewhere, the segmental structuring is prominent in curriculum and knowledge seems to accrue by aggregation instead (Muller 2009).

Anatomy is afforded more legitimacy in the operating Human Biology curriculum on account of teaching contact hours and evaluations:

> What you're actually telling the student is that anatomy is more important than physiology. Which is incorrect because both are integrated, it's structure with function. You are telling them that it's only structure that's important because they've been tested more on structure whereas function is just as important.

This is one half of the interdisciplinary narrative, and in the next section I consider a physiology perspective.

7.3.2 Organisation of physiology practices

In this section I supplement the earlier analysis of documents about the organisation of Physiology. I interviewed a senior academic to explore the positioning of physiology in the HUB curriculum. I use the pseudonym Lex to protect his identity.

Framing of curriculum decisions

In order to understand where control resides for decision-making and overall positioning within the structure of curriculum, I explored as I did in the case for anatomy, the framing of the physiological content, scope and sequence. Lex had this to say:

> So the thing is, the … the question about the curriculum decisions and who makes them, is … is riveting because I think there has been a mind shift over the last five years in that … and I think it has come from both HUB and from Health and Rehab Sciences in that we … we all felt the need that the Health and Rehab Sciences had to talk to HUB … human biology because the course was so – was so linked to each other.
>
> And before that I think the baggage of the past was that you know human biology went on their own. They designed their course of anatomy and physiology and they ran it … finished. The … I think of late, over the last two or three years, we definitely talk more to Health and Rehab Sciences in terms of the curriculum design … in terms of the … of what we're doing at a particular time of the year and we're trying

to keep it as fluid and as flexible as we can. (...) but ja I think – I think for the anatomy and physiology the decisions still remain with HUB.

Lex reflects some conversations with the School for Health and Rehabilitation Sciences which appears to be more about flexible timing and delivery, rather than sequential planning. For anatomy and physiology the decisions remain with HUB which in practice means the course convenors of years 1 and 2. The move to interdisciplinarity brings together many different identities, disciplinary communities and cultures, academic values, different ways of understanding teaching, learning and assessment (Mathieson 2012) and conversations need to involve all relevant parties in looking for integration opportunities (Reddy 2011). This was previously emphasised in the case of anatomy.

I asked the lecturer how he decided on curricular content:

Lex: So there are two parts to the answer. The one is I guess carried over from the days of old of a very structured very pedantic … a very pedantic sort of curriculum structure. And … so that's the part of the baggage that has come from the past (…)

G: Inherited?

Lex: Inherited exactly, that's a good word to use.

The academic reflects a view of a time when the disciplines were highly classified with strong boundaries and considered silos. Indeed the move to interdisciplinary programmes was strongly endorsed by the Department of Education (DOE) in the 1990s and integration in curriculum was viewed by many as desirable (Ensor 2003, Muller 2009). There are many who consider interdisciplinarity more egalitarian as the connections between subjects are envisaged as making the knowledge more accessible. But social realists have argued that knowledge integration and abstraction requires delving deeper into the disciplines, not absenting them (Moore 2011, Muller 2011, Young 2013, Muller and Young 2014, Wheelahan 2007, 2010) (refer to Chapter 3 for elaboration). Possibly in response to what Lex regards as a very structured system associated with times past he relates his present role to freedom of content choice:

> Well, I think you know we're convening the course so in terms of the … of the freedom, I think we're … we're pretty free to select what we want.

The weakening of classification could indeed serve the purposes of better integration for professional learning, however such freedom needs to be carefully managed so that the knowledge structures of the composite disciplines are not undermined in such a process (Wheelahan 2007, 2010 Winberg et al 2016). Selection of physiology content is located with the Physiology convenor and apparently little if any discussion with Physiotherapy or Occupational Therapy. This increases the potential for slippage and for the inclusion of content which may not serve the best interests of the professions.

Lex framed his organisation of content in the curriculum along principles of 'diseases of lifestyles' and relevance to community health, as the extract shows:

> … I think the applications of a lot of the subjects obviously had to change with the current knowledge of … the current clinical knowledge that we have. Like the increase in diabetes you know, the advent of HIV/AIDS etc. So … so I think … I think the essential knowledge of the topics are important, have been tailored as we've gone through the last couple of years (…) I've tried to make it a bit more relevant in terms of the current clinical problems that we encounter now …
>
> … we introduced nutrition … nutrition in lifestyle (…) and that sort of comes in after we've done metabolism regulation, metabolism endocrinology. So that I think is quite powerful and quite essential knowledge. (…) of course with sexual health and … and sexual reproduction also being quite a … quite a critical topic, very often related to lifestyle these days, obesity etcetera I think it's also important.

In the second year of the Human Biology curriculum, physiology has come to be represented by a focus on general metabolism and on reproductive physiology. The learning objectives as reflected in the interview data revolve around diseases of lifestyle, sexual health, diabetes, nutrition and obesity. Issues of relevance and application have

been part of the higher education discourse for some time (Ensor 1998, Beck and Young 2005, Muller 2009). There is strength in this, however most of the topics Lex talks of would be relevant within a medical or medical sciences framework, and are not necessarily relevant to physiotherapy and occupational therapy students.

Further exploring the framing of the course and the sequencing of and between the disciplines, it appears that the physiology component is not necessarily conceptually coherent and may be sequenced according to the availability of teaching staff (in both disciplines). I enquired whether he believed that the segmental arrangement of the course makes sense to students where for example head and neck anatomy is followed by a section on metabolism then endocrinology, anatomy of the hand and four or so lectures on anatomy of the pelvic floor. Although an attempt had been made to align some anatomy to coincide with a particular clinic at 'health and rehab sciences' request, the physiology lecturer agreed that curriculum sequencing needs review:

> … there's no doubt about it … I think it's quite, just looking at that at the moment, it's quite jarring, the different anatomy to physiology topics.
>
> But part of the anatomy was … was almost directly linked with the alignment with health and rehab sciences or at least we tried that last year (…) we had tried to focus on the alignment because I remember that for example, the head and neck, they needed … the health and rehab sciences told us that they needed the students to know about the anatomy of head and neck first time. Because very early in the second year, it started the second year they were going to a … to a clinic or they were going to do a workshop or a course where they needed that knowledge. So that … throws out our … our sort of logical sequence of the curriculum and for us (…) made sense to try to align for them. So (…) that's part of the difficulty to be honest...

Framing of sequence and to an extent content at times appears to alternate between anatomy and HRS. For physiology content, Lex's account expresses freedom of choice, yet this needs careful management and discussion with all parties so as to maintain the

basics that the professions require. In the interdisciplinary context physiology seems to be less powerful than anatomy in curricular framing. The flexibility to move segments about without due consideration to curricular organisation has disrupted the 'logical sequence' (Lex) and contributed to the lack of synergies between the disciplines, and the lack of coherence between year 1 and year 2. Overall, the hierarchical structuring of physiology loses its shape and when a discipline loses its core structure it in turn fails to facilitate cumulative learning (Muller 2009, 2015).

How knowledge-building is envisaged in physiology

I probed the lecturer's perception of what distinguished physiology knowledge, and his experience of students' grasp of physiology as compared to their ability to learn anatomy. He identified the challenges of learning physiology 'because it's more conceptual' and that concepts need to be applied and because of this physiology is more than just identification and memorisation that has become associated with gross anatomy:

Lex: I think they … they struggle with physiology simply because of the nature of learning physiology. Because it's much more conceptual ... it is not just an identification as (…) for anatomy. I think it's much more of an applied … of an applied science to the concepts and I think that's why … and that's why they struggle because their learning methods that they come in with are not geared from … from day one. Their learning methods are not geared to learn in a … in a conceptual way. It is more you know here's my lecture … I learn the slide …

G: from memorisation?

Lex: from memorisation, by rote learning whatever you want to call it and then … and then regurgitation.

There is acknowledgement of the difficulties that students experience with learning physiology which is conceptually rich and reflects high condensation of meaning within any particular concept (SD+), and furthermore the linkage of concepts requires students to hold together condensed concepts and be able to consider them not in a discrete way but at a systems level with movement from stronger SG of a specific aspect to weaker

SG of a whole system. Lex understood conceptualisation to be challenging for the neophyte student and furthermore that when conceptual knowledge needs to be applied (to patients) it adds a further dimension of complexity and requires considerably weaker SG. However rather than considering the human biology curriculum structure itself to be a challenge to students' conceptualisation development processes, he perceived accountability to lie with 'teaching methods that they come with' and that high school biology is not required for admissions.

> …or you just have an innate ability to … to you know, synthesise and now to start understanding concepts in a sort of physiological way it's very hard by second year to be up to speed if you haven't received it [school biology] for the last five years. So I think that's – it's a critical issue.

The reference to innate ability suggests an understanding that adeptness in making conceptual connections is here understood to be a born gaze (Maton 2014), which one either has or does not have, rather than a function of the curriculum structure and pedagogy. Furthermore, students' difficulties with understanding physiology are framed in nearly all this interview data in terms of a deficit discourse, with the problems located external to the Human Biology curriculum for example the 'methods they [students] come in with' (Lex). Boughey (2005) reports that students carry understandings from their home background into the academic context which may then lead to unproductive academic learning; the issue however is a 'misreading of context' (Boughey and McKenna 2015, p8) which is not made explicit, rather than a learning ability inherent in the individual.

Reflecting on the course purpose, Lex conveys his understanding of integration to mean that first year and second year should be coherently linked.

> Okay, so … so the human biology course as … as you know was designed first to be a combination of – of a complete two year course where first year and second year was not supposed to be that separate. And that the learning progression was supposed to be from

> the start of first year to the end of second year. And I think that's why we attempted over the last few years to integrate it more.
>
> I think in second year, I mean we take it for granted that they … that they have the basics in first year. So they come … they come in to second year with that foundational knowledge in place.

It may be problematic to 'take it for granted' that students 'have the basics' given the concerns raised by Jenna and given the literature arguing that building knowledge cumulatively requires explicit linking to prior knowledge bases (Maton 2014). There is also the concern that the two year course is meant to collectively form the foundation and integrate knowledge so as to understand the human body as a complete organism (FHB2004-13), and so is somewhat at odds with this statement which seems to understand the two years as separate, with the first year being foundational.

> … we build it up from where they left off in – at the end of first year (…) we tend to concentrate more on the systems in second year, physiological systems and so we … we build it up from there to expand more and using their foundational knowledge and applying that to the – to the systems (…) They'd have to know generally that … that an organ is made up of cells because we start talking about organs. (…) So that progression I think is absolutely critical for them to know and to apply...
>
> I try … to start at you know … with an extremely brief revision at the start of the module and then build …

In the previous excerpt the academic indicates more specifically what he views as the necessary basis for students incoming to year two - the cellular basis of organs. From course data analysed earlier in this chapter, it is clear that there are two complex systems – cardiovascular and respiratory – which are taught, albeit seemingly inadequately in first year. Students are already exposed to systems in year one although not as integrated systems because physiology has been somewhat relegated. Having established that anatomy in year one is legitimated as more powerful knowledge than

physiology, it would be problematic to assume year one of the Human Biology programme to be foundational to physiology.

There appears to be little reflection on the extent to which the disciplinary teaching platform is responsible for inculcating the processes of knowledge-building and the abilities to strengthen and weaken SG along its continuum as required for clinical professions. Morrow (2009) makes clear that to enhance the likelihood of students acquiring epistemological access to the powerful knowledge of the disciplines, our pedagogy has to be focused on making the norms of disciplinary knowledge explicit. On certain occasions outside of the classroom, the lecturer attempts to get students to apply their knowledge in different contexts, more abstracted, diverse and complex. Lex revealed how he used tutorials to develop students' reasoning:

> … in metabolism module for example, I would tell them for the tut to bring a chocolate, bring a chocolate wrapper with them, the chocolate can be inside or not. But … and then we actually analyse the nutritional information on the back. And we actually work out from that nutrition information and obviously in doing that, they'll learn what a calorie is, what a kilo calorie is all about, what a joule actually means, nutrition means and how … and I also then highlight everything that we've been talking about in terms of metabolism you know and the proteins in the chocolate and the glucose in the chocolate and I will use that as a … as an example to just revise a couple of concepts that we have done in the lectures. But something like that which I think is … is reasonably simple in terms of a chocolate, they never look at a chocolate the same way again, as a matter of interest after that … but it always reminds them that … that they have to apply their knowledge that they're learning and I try to emphasise that a lot in my … in my lectures.

This example envisages an exercise in alternately weakening and strengthening semantic gravity and semantic density, and creating a wave up and down the continua which represents cumulative learning (Clarence 2014, Maton 2013, 2014). For example the chocolate (SG+) to a concept of kilocalorie (SG-); from glucose listed on the wrapper

(SG+/SD-) to a concept of glucose metabolism (SG-/SD+). Nevertheless, the relevance to the clinical fields for physiotherapists and occupational therapists is questionable.

The scheduling shows, however, that tutorials and opportunities for the students to integrate their learning into practice are few and far between. The ideal space for cumulative learning is the physiology experimental laboratory but that teaching modality has been lost since the merger in 2004. To really evaluative whether integrative, cumulative learning were occurring, classroom observations would be needed and student assessments should be analysed.

Physiology as a basis of the rehabilitative health professions – a lecturer's perspective on specialisation

> … so that the students particularly for human biology for physiology got a continuum on the first year all the way to the end of second year (…) I think the purpose is predominantly that … that you finish with students that have a very good grounding in physiology and anatomy by the end of the second year ...

The conflation of 'human biology for physiology' indicates almost a relativist or generalist epistemic specialisation for physiology with epistemic relations weakly reflected. The weak classification and framing of physiology that I have argued to this point is further reinforced when Lex at first considered the dual narrative of 'physiology and anatomy' before commenting on his speciality of physiology. There is a strengthening legitimation of physiology on an epistemic basis where it is conveyed that the knowledge 'can apply in their clinical years' of study:

> I think the overall answer is that the purpose was … was meant that over two years they get a very solid foundational grounding in physiology that they can then apply in their clinical years, in third and fourth year.
>
> I think in terms of the physiology of the physiological knowledge, I would hope that it … that it is the same for the physiotherapists and the occupational therapists. I think from the end of second year and as

> they go into the more clinically relevant fields, of physiotherapy and occupational therapy, we would hope that the translation of the … of the knowledge that they've gained in first and second year can be slightly tailored more towards their clinical … clinical field. But I think foundationally … I think it is important that they're learning the same basic physiology.

Lex neither differentiates epistemically what it is that physiology contributes to the foundational curriculum, and nor does he differentiate the different knowers as being physiotherapy and occupational therapy students. However when probed whether the purpose of physiology was the same for both professional cohorts, his response was uncertain and he regarded it as incumbent on the Physiotherapy and Occupational Therapy Divisions for the 'translation' and 'tailor[ing]' towards the clinical field.

In wanting to reveal more about the social relations underpinning physiology's organisation in this course I asked the lecturer what he would expect from the student with regards to physiology. His response identified his own identity strongly as a research scientist, rather than a particular disposition or gaze expected of physiotherapists or occupational therapists:

> Right, so … so what I … and it's probably because I'm a scientist, what I would lead off with for example, let me give you an example of one of the tutorials sections would be giving them a headline from a newspaper or a headline from a journal article and ask them a few questions that would require them to actually go into their notes but also I'm very much one to … you need to expand your knowledge a little bit beyond your notes (…) actually need them to go to you know a couple of websites, go possibly read … read some newspapers, read shortened journal article possibly to actually get information that they can then synthesise and actually put together (…) basically each one of them will have to give feedback relating to this … to this set of questions that I've actually given them.

It is anticipated that the student cultivates her gaze and strengthens her social relations to become a reader, an analyst of information; to 'synthesise' and 'put [knowledge] together' (Lex) and possibly become more research-orientated. Tutorials are it seems, underpinned by relatively strong SR as well as ER+. The course outlines for each profession, which were analysed in Chapter 6, did indeed stress the strong SR aspects of the professions but not in these terms – rather in terms of their commitment to the person they are treating. For the occupational therapist this entails restoring the person to meaningful occupation (FHB1994-13) and for the physiotherapist it means restoring function by physical therapy after injury or surgery (FHB1994-13). The Physiotherapy Division does however indicate in its vision statement that it would like to educate 'physiotherapists who will be well prepared to meet the health, rehabilitation and research needs of our country' (FHB2005 p41) and research methodologies are part of the 3rd and 4th year programmes.

From the physiology perspective, this interview data indicated that a focus on teaching basics of the professions was not clearly demonstrated. What was deemed as relevant by Lex was more generalised to diseases of lifestyle and community health which is consistent with the research impetus at the faculty. This raises a caution that such focus on the context can reduce access to powerful knowledge (Wheelahan 2007, 2010).

Summary: contestations about what is legitimated

A quantitative analysis of the Human Biology curriculum (Section 7.2) showed anatomy to have a considerable weighting of content and teaching time. I asked if this might send a message to students that a certain discipline was more important, and if it did, would that be problematic for the student coming out of the two-year basic curriculum.

> I would fully agree with that actually that it would be problematic for the student to think that the one was more important than the other. And I think that's … that's why part of the idea would be to market this as a two year course from the get go. So that the student realises that look, there's a certain amount of anatomy that is going to be covered over two years and there's a certain amount of physiology that is going to be covered over two years. Whether you're getting all the anatomy

> in the first year and all physiology in the second year or whether it is mixed, that is the amount of anatomy that is going to be covered, that is the amount of physiology that is going to be covered and we're taking two years to teach it to you.
>
> And I think if it's marketed in that way then … then the student won't assign importance more to the one or to the other. And should … and I mean shouldn't really be thinking of it as heavily laden with anatomy necessarily in first year and that's where the anatomy is more important.

There remains the question of what the imbalance in physiology content in this service course might mean for clinical studies more immediately and the professions in the longer term. As students graduate from the basic course to enter clinical studies their performance in physiology is masked by the way the course is constructed and how assessments are assigned according to an intended integration. It is important to distinguish how physiologically prepared students are, especially students of physiotherapy since it is a stated requirement of their profession (as discussed in Chapter 6). The problematic of submerging physiology performance is highlighted in the following interview data:

> … by the time they write that end of year paper it is two integrated , it is two papers that have anatomy and physiology. And so if I am … if I am … if I know that I'm struggling in physiology I am logically going to concentrate a lot on my anatomy to pull me through (...) but the overall mark that is eventually reflected and is a reflection of how the student has done is a combination of both. So you … the concept of struggling in physiology necessarily is lost (...) if you were to just look at physiology, you'd probably find a very different picture…
>
> but the scary part of it is that you could theoretically have a 40% physiologist, 75% anatomist and the student finishing on … on 65%. Now within that 65% if the physiological knowledge going into the clinical … into the clinical third year is needed, you've got 40%

> physiological basis that you're working with which is the … the scary part.

The lecturer revealed rather emphatically that the purpose of human biology in second year is for students to learn more about systems:

> we tend to concentrate more on the systems in second year … physiological systems and so we … we build it up from there to expand more and using their foundational knowledge and applying that to the … to the systems to more of the systems biology

Systems biology is a mutually inclusive situation, anatomy and physiology integrated in how the system is understood to work. However the basis of student achievement is not considered as an integrated understanding of biological systems. Student assessment separates anatomy (structure) and physiology (function) of the systems as is demonstrated by the following:

> So the class test will have an anatomy component and a physiology component ja. But I'm saying within that paper, the … even if it's cardiovascular say and they did you know two weeks of cardiovascular anatomy and they did two weeks of cardiovascular physiology, there won't be one question that is an integrated question of both anatomy and physiology. It will be the anatomy for 10 marks and physiology for 10 marks.

Findings of my study clearly show that while the ideal of disciplinary integration is repeatedly expressed, in practice the silo effect seems to be maintained in the Human Biology curriculum. Lex concludes:

> Let me put it plainly…the aim is integration but the final … test is not integrated. There's no … there's no question about that. That's the honest side of it. And I think that it would need really the anatomists and the physiologists to really sit in a … in a real engaging type of way to come up with something…

A tension appears to exist between what is required for understanding physiology, which is conceptually complex and requires of the student an adroit ability to weaken and strengthen semantic gravity as the situation demands, and the type of rote learning that is perceived to be occurring. It may be reasonable to suggest that students entering year two from first year where anatomy is the dominant power, and where the data suggest that achievement is largely validated by the ability for identification, would be carrying this forward as they progress. Because, as Lex pointed out, students can pass the course even as a '40% physiologist' on the strength of their anatomy, many may persist with context-dependent learning. While this SG+ meaning-making may seriously impact in clinical studies, it appears to enable passage through the foundational HUB course.

Those instances where cumulative learning could be inculcated, for example the physiology tutorial setting, are not only thinly dispersed in the teaching schedule but particular topics seem not to relate to the requirements of the professions:

> … there's more than enough topics to talk about you know (…) sexual reproduction and health … more than enough you know pregnancy, fertilisation, you know IVF, that type of … type of topics.

There seems to be some kind of acknowledgement that the physiology modules may not be all that suitable because the academic conceded that he 'would like to get a group of physiotherapists who are in clinical practice and a group of occupational therapists and bring them together and say, these are the lectures we're teaching now, these are the topics, what do you think now having been in the field for three or four years now outside of university. What do you think is most relevant of this pool of topics? And I'm sure you'll get a very different – we'll get a very different view on – on what we should be maybe emphasising more and what we should just drop completely'. Lex seems to reach for opinions of newly qualified practitioners rather than faculty's own physiotherapy and occupational therapy professionals and academic educators. Inadequate consultation and collaboration between all curricular stakeholders could lead to a misalignment of the fundamental sciences with the professional subjects.

7.4 Concluding remarks

Even when integration is explicitly stated as the course objective, the merging of subjects into one course has not lead to integration. Ironically the problem of silo teaching has persisted through the form the human biology curriculum has taken.

In the move to an interdisciplinary Human Biology curriculum, the steeply hierarchical structuring of physiology lost its shape. Historically (Krogh 1929, Rothschuh 1973, Fye 1986, Borell 1987) and corroborated in this study, physiology's strong classification (epistemically and culturally) as an experimental laboratory science where basic principles of biophysics and biochemistry – the pillars of the discipline - are demonstrated as underpinning theoretical knowledge, has been relinquished. An essential pedagogical space was lost. The collapse of disciplinary structuring at the same time breaks down the boundaries necessary for transcendence and cumulative learning (Muller 2009, Maton 2009, Wheelahan 2007, Muller and Young 2014).

Prior to the merged programme of Human Biology, the Physiology for Physiotherapy course was specialised by elite coding imbued by strong ER and strong SR. Physiology practices and contexts were also organised by principles of rhizomatic coding (SG-/SD+). Physiology for the occupational therapist was characterised by a weak knowledge code with practices and learning relatively context-dependent thus SG+.

Documentary analysis showed that the Anatomy for Physiotherapy course was underpinned by a fairly strong knowledge code, while the Anatomy course for the occupational therapist was considerably weaker. The weaker epistemic relations and social relations of Anatomy for Occupational Therapy was essentially due to the absence of histology (micro-anatomy) which characterised the practical space predominantly as learning gross anatomy by identification of structures visible with the naked eye. This differentiation between the courses for the different professions also added a principle of weaker semantic gravity to Anatomy for Physiotherapists. I argue that gross anatomy of itself is not much of a hierarchical knowledge structure, however micro-anatomy adds complexity and conceptualisation, thus making the discipline more hierarchical.

Analyses indicated that in the process of integration, physiology underwent a code shift, no longer underpinned by an elite code (ER+/SR+), shifting instead to a knowledge code

(2004-2008) underpinned by reasonably strong ER, weaker SR. Physiology from 2009 – 2013 is underpinned by even weaker knowledge code aligned more with the OT Physiology programme before the merger. Physiology as currently positioned in the interdisciplinary programme, no longer matches the elite code required by Physiotherapy. With the abandonment of laboratory demonstration of basic biophysics and biochemistry principles (physiology) the rhizomatic code (SG-/SD+) underpinning meaning-making and application of physiological knowledge across diverse contexts and practices has also been relinquished for the physiotherapist, not so for the OT. Cumulative learning appears not to be supported.

Integration into HUB has weakened anatomy's underpinning knowledge code in the case of physiotherapy, since micro-anatomy was removed from practical sessions. There appears to be little change for occupational therapy students. There is partly a regional approach and partly a sectional approach dependent on the lecturer. It seems that over the two year curriculum anatomy has in most part become a disconnected collection of segments and findings suggest, though are not definitive, that learning by identification and memorisation is validated.

Data from documents and interviews inclusively, indicate that overall sequencing of the Human Biology course does not build a coherent picture for the student and the curriculum is highly segmentally organised. The foundational programme demonstrates under-emphasis on physiology content, which is often based on relevance seemingly unrelated to the required professional knowledge. Physiotherapy is explicitly based on physiological principles (FHB1994-13) and has been most affected by the transition to interdisciplinarity. Power resides with anatomy in the basic curriculum conveying the message to students that anatomy is powerful knowledge. Anatomy controls the evaluative arena of the two year HUB course meaning that students can graduate from the foundational course with imbalance in their knowledge of the fundamental biomedical sciences.

CHAPTER 8. CONCLUSIONS

In this final chapter, I give an overall summation of the key findings of my study. In answering the research questions I have been able to characterise the principles underpinning the practices, contexts and dispositions of physiotherapy and occupational therapy and their respective educational programmes. Using LCT tools of Specialisation and Semantics enabled me to analyse extensive Faculty and Departmental documentation and very rich interview data. I was also able, through the use of LCT, able to rigorously analyse the disciplines as organised autonomously in courses for PTs and OTs both prior to as well after, the emergence of the (current) interdisciplinary Human Biology curriculum. I will also extrapolate my findings to other contexts where, for instance, I feel the study can contribute to more generalised fields. Lastly, I address possible limitations of my study and indicate how I would like to continue my scholarly pursuits in this very exciting field.

8.1 Reflecting on the extent to which the study has answered the research questions

> To what extent does the structuring of the foundational Human Biology curriculum shape students' access to professional knowledge?

My research questioned the extent to which the Human Biology curriculum served as a fundamental basis to the acquiring of professional knowledge for the rehabilitative health professions of PT and OT. There were several components to my analyses: firstly I used Specialisation and Semantics to explore the organising principles underpinning practices, contexts and dispositions of the professions and professional programmes of Physiotherapy and Occupational Therapy; secondly I used the same LCT tools to explore the organising principles of anatomy and physiology as they existed autonomously in the separate foundational courses for each profession (up to 2003), and then as the disciplines were integrated into a single Human Biology foundational course for a combined class of physiotherapists and occupational therapists (from 2003/4 until the present day); thirdly by using semantic gravity, I analysed whether cumulative learning

(and epistemological access) was enabled or constrained by the structuring and organisation of the foundational curriculum. The following reflects my key findings.

8.1.1 Organising principles underpinning the professional practices, contexts and dispositions of Physiotherapy and Occupational Therapy

The findings of my research have shown that the physiotherapist graduating from the Physiotherapy programme at the research site is envisaged to be specialised by elite coding with dominant and explicit epistemic emphasis, yet also legitimised by strong social relations. The social relations realise the practitioner as having the attitude, aptitude and disposition of a clinical assessor, problem-solver and solution finder. Less explicit perhaps, is that the practitioner should also cultivate the gaze of a researcher. The physiotherapist needs to integrate professional knowledge from the site of acquisition and apply it across diverse and complex clinical contexts. Some of these contexts are assessment/patient evaluation, diagnosis and differential diagnoses, as well as treatment in a variety of settings from clinic to hospital, urban to a peri-urban or rural. The requirement on the student knower / graduate professional is a robust and sophisticated ability to move up and down the semantic gravity continuum by weakening SG to abstracted contexts and strengthening SG to the context of the clinical case. The concept of 'treatment' has a constellation of concepts condensed into it, thus strong semantic density. Physiotherapy practice is characterised by (SG-SD+) a rhizomatic code.

The occupational therapy graduate is envisaged also as specialised by elite coding where the epistemic relation is weakly legitimising while the social relations is strong focusing dominantly on the humanistic nature of engaging with clients. While not explicit, the epistemic basis reflects knowledge of dysfunction which derives from knowledge of function and the data showed that this requires knowledge of joints (anatomy) and knowledge of muscle function (physiology). The therapist is also required to be assessor, yet this does not require clinical diagnosis as in the case of the physiotherapist. The OT works across a diversity of contexts, one of which is, for example, the assessment of level of dysfunction in the case of a client's return to work. The practitioner requires the ability to integrate basic concepts into professional procedures which means an ability to weaken SG. However this abstraction is not to the same extent as that required of the

physiotherapist. There is fairly dense condensation built into a term such as 'assessment' which involves interpretation of range of movement, muscle tone tests or other diagnostic tools, and the semantic density of the practices of the occupational therapist are considerably weaker than physiotherapy.

My study has shown that the rehabilitative health professions have differential epistemic requirements of the fundamental curriculum and the disciplinary knowledges. Each has a different conceptual basis and a different focus:

Perspectives from the physiotherapy clinical educator reflected that many a clinical student finds it difficult to draw on basic knowledge and apply it in the clinical arena. The challenge of reasoning and application of knowledge in clinical or other professional contexts is well documented (Glew 2003, Rowe et al 2012, Tufts and Higgins-Oppitz 2009, O'Connor 2011, McNamara 2010, Wheelahan 2010, Winberg et al 2011, 2016). My study revealed gaps in knowledge specifically in neurophysiology, immunology and the inflammatory response, and the cardiorespiratory system. Also there is overemphasis on less important anatomy, while essential anatomy such as that of the lumbar spine is not given enough attention. From the clinical perspective, many students present as non-confident, and consequently struggle to weaken semantic gravity in their clinical practice. It appears they want to be instructed on what to do. This seems to reflect that students have not acquired the required basic and fundamental knowledge in the first place, and that students have not learned by subsumptive, cumulative means how to integrate knowledge into context-independent meanings.

From the occupational therapy clinical perspective, even advanced final year students are prone to struggle with assessment and 'fall apart'. Others seem reluctant to put knowledge to work, and would prefer to be told how or given the 'recipe' (Ella). Findings indicate that several occupational therapy students struggle to apply knowledge to generalised, abstracted contexts which are independent of the site of acquisition. Knowledge gaps were identified: for example, students were reported to not have basic knowledge about joints, and to not understand dysfunction. The educator understood the onus to be on the student to integrate knowledge, which is arguably not within the

scope of the novice student, especially those coming into higher education from an inequitable school background.

8.1.2 The move to an interdisciplinary curriculum: positioning of the disciplines and the realisation (or not) of integration

Physiology and Anatomy ran separate courses for physiotherapists and occupational therapists before the move to interdisciplinarity. Physiology for physiotherapy students was specialised by strong epistemic relations, while considerably weaker epistemic specialisation was realised in the physiology course for occupational therapy students.

The PT Physiology course before the merger had a knowledge structure which was steeply hierarchical or vertical (Muller 2009). The educational/training programme emphatically states that physiological principles and procedures are a measure of distinction for the physiotherapy profession and that the practitioner's ability to apply effective patient treatment integrates these fundamental principles. The laboratory or practical session stipulated in the autonomous Physiology course was a pedagogical space for the physiotherapist to learn how to apply physiological principles to the clinical arena.

The OT physiology course was generalised with no laboratory component, realising considerably weaker specialisation of physiology knowledge for the occupational therapist, and other cohorts like dieticians and pharmacology students.

The Anatomy course for the two professions appeared from documentary findings to be similar for the most part insofar the epistemic stipulations were concerned. Only the physiotherapy students, however, had a histology component. This added a microscopic dimension to their anatomical studies, which strengthened epistemic relations and also social relations to the extent that the student needed an aptitude and attitude to go beyond the gross presentations visible with the naked eye. This transferred learning to a more abstracted realm thus weakening semantic gravity. The knowledge structure when histology was included can be considered as hierarchical but arguably not strongly so. Epistemically, anatomy was mapped weaker than physiology.

In the interdisciplinary Human Biology programme both disciplines lost their shape and structure to a greater or lesser extent. My findings show that physiology's autonomy

weakened and the discipline lost its formative core. The dissolution of physiology's external and internal boundaries (scaffolding) impeded students' access to disciplinary knowledge practices thereby undermining epistemological access. When opportunities for students' cumulative learning are lost, a social justice argument loses its focus and traction.

Physiology's development as a discipline autonomous from anatomy was distinguished by its positioning as an experimental science. I refer the reader to Chapter 2 where at the turn of 20th Century it was mentioned how important the laboratory was as a pedagogic space where students acquired skills of rational enquiry and scientific reasoning rather than just memorising facts (Borell 1987). My study showed that physiology's strongly bounded hierarchical knowledge structure lost verticality (Muller 2009) and simultaneously its coherence and sequential structuring. Additionally, it lost strong condensation as a practice when it was relegated from its position as a stipulated senior course (a position it had held since the origination of the Medical School as described in Chapter 2). The laboratory space which previously represented a pedagogical arena for learning about the application of physiological principles to clinical contexts, was relinquished.

In the Human Biology curriculum, my findings revealed that physiology is underrepresented in evaluations, in contact teaching events and extra-classroom teaching activities. In the specialised area of neurophysiology expertise is undermined and disciplinary boundaries blurred as an anatomist assumed responsibility for teaching of this specialisation. Anatomy holds the power in the recontextualising and educational fields of the EPD.

In curricular organisation there is disconnect between first year and second year modules. Second year physiology lectures coalesce around relevance to diseases of lifestyle which indicate both a loosening of disciplinary boundaries and structuring, and relevance is related to medical science rather than the fundamentals of the rehabilitative professions. Coherent conceptualisation (Muller 2009) is interrupted by insertion of anatomy segments. The human biology curriculum is overall segmental, where units of study form loose aggregations with little if any continuity between what

has been previously learned. This segmental non-sequentially organised syllabus (curriculum) promotes segmental teaching and learning; conversely a coherent cumulatively organised curriculum is likely to enable cumulative knowledge building by students. When knowledge is locked into pedagogic contexts, it problematises students' ability to integrate meanings and transfer understanding across new contexts, including their ability to apply meaning to later studies and future work (Maton 2012, 2013, Wheelahan 2010, Winberg et al 2013, Young and Muller 2014). It is understandable then that both the physiotherapy and occupational therapy clinical educators interviewed in this study, reported students' difficulties with applying knowledge in clinical contexts, and their conjecture was that students were struggling to integrate basic principles. My findings support that curriculum organisation has become segmental and consequently knowledge builds by aggregation (Bernstein 2000, Maton 2009, Muller 2009). The structuring and organisation of the Human Biology curriculum has compromised cumulative learning and the ability for integrative knowledge-building.

Anatomy for physiotherapists also lost a laboratory component (micro-anatomy or histology) with the integration of the two disciplines. In this way the discipline became entirely focussed on gross anatomy - structures such as bones, muscles, nerves and joints which are observed in cadaverous specimens. The relinquishing of histology made learning of anatomy more context-dependent. The segmental organisation adopted in the human biology curriculum interrupts the regional approach ostensibly adapted. Evidence showed that the upper limb region is covered in first year only to the forearm, with the wrist and hand resumed a year later in a disjointed and non-sequential arrangement. It is unsurprising that students are misunderstanding the basics of anatomical connectedness and how joints work, as Ella the occupational therapy professional reported for the clinical assessments, and which Jenna reported from her perspective as an anatomy teacher.

Claude Bernard's global perspective was that one should view the human body as an 'integrated whole' (Rothschuh 1973, p269). So too, the former Head of Department of Physiology stated that the objectives of the Physiology course were 'to educate students to see the body as a whole' (Inyanga 1983, p21). Integration is a stated goal of the Human Biology course (FHB2008 -13). However the operating Human Biology curriculum

falls short of these integration objectives and consequently constrains access to professional knowledge. My analysis has shown that despite intentions to achieve efficiencies and promote interdisciplinarity this has not been achieved. By locking students out of disciplinary structures and practices, epistemological access is denied and this may ultimately defeat the social justice imperative (Moore and Young 2001, Morrow 2009, Wheelahan 2007, 2010, McKenna 2012, Maton 2009, 2011).

8.2 Significance of findings and contributions of the study

The move to interdisciplinarity has been a general and global trend (Beck and Young 2005, Moore 2011, Maton 2011, Muller 2011). In South Africa interdisciplinary teaching (and research) was congruent with democratisation of higher education, and complied with the efficiency discourses and managerial practices that emerged with the new millennium (Lange and Luesher-Mamashela 2016). In the health sciences mergers and restructuring are not uncommon, yet Zungolo (2003) reports that the impact on curriculum, teaching and learning is seldom considered. My study showed that disciplinary integration is not necessarily well considered, and foregrounds the need for fully consultative curricular design in all cases, and perhaps there is an added imperative in the health professions which ultimately realise treatment of patients. If aside from the interdisciplinarity of the teaching programmes, there are also merged cohorts of participant students, then a sound understanding of the epistemic requirements of each profession is required. Mergers and interdisciplinarity can be researched in generalised contexts, at any university, any disciplines, and any relevant knowledge practices.

In the move to interdisciplinary curricula, various aspects need to be deliberated. When merging disciplines within an integrational objective, the different knowledge structures and boundaries need to be considered in their recontextualisations to curriculum and pedagogy (Wheelahan 2007, 2010, Muller 2009, 2011, Young 2014, Young and Muller 2014). The emergent course needs to attend to the demands of teaching and learning practices of each contributing discipline and power should not be invested in one discipline at the expense of the other (Muller and Young 2014). As Muller (2011) argued, it is possible for disciplines to retain their shape, identity and character within an interdisciplinary programme if the process is carefully managed. If the formative disciplinary core is lost, disciplinary structures become disconnected and teaching and

learning becomes segmental. Having pointed out that physiology lost an integral part of its pedagogical repertoire and its autonomous identity when laboratory teaching was lost, I invite the reader to imagine the consequences for student learning if for example laboratory teaching were absented from courses like chemistry or physics.

In the interests of social justice every educational course needs to provide epistemological access. Integration needs to ensure access to powerful foundational knowledge which ensures cumulative learning. Neither the integration of the course nor the focus on how the knowledge will be applied in the workplace should undermine the acquisition of such foundational knowledge (Wheelahan 2010, Winberg 2013, Muller and Young 2014). Integration can indeed serve the needs of a profession by helping to make connections to the world of work - and this requires that those teaching on the course (collectively) meet with and understand the values of the professions. Crucial in good curriculum design is ensuring dialogue that will help students make connections from abstract theory (SG-) to the context in which the knowledge will be used (SG+) and likewise enable the ability to weaken semantic gravity from the point of knowledge acquisition (SG+) and apply it in a multitude of work contexts (Maton 2013, 2014). Thus putting knowledge to work in various contexts of professional practice requires of the knower to continually decontextualise and recontextualise (Evans et al 2010).

Genuine integration requires deep commitment from all parties and regular discussion between those teaching various aspects (Mathieson 2012, Reddy 2011, McNamara 2009). This is needed so the linkages, connections, scaffolding and contexts of application are made explicit. Student enablement requires that the bases of achievement are made visible, and what counts as legitimate knowledge is explicit (Maton 2000-2016). All parties need to acknowledge the need for retention of core structuring and the importance of sequencing in conceptually-rich, vertically orientated, hierarchical disciplines, and make explicit to students boundaries of disciplinary knowledge to enable their transcendence (Ashwin 2014, Bernstein 2000, Muller 2009, 2011, 2014, 2015, Muller and Young 2010, 2014, Winch 2013, 2014). The retention of disciplinary experts is another important consideration in establishing cooperative, collegial manifestations. At the beginning of last century, the Nobel laureate August Krogh (1929, p8) emphasised the need for combined efforts as opposed to isolated silo

endeavours to expedite learning – 'experimental physiologists cooperate with histologists, with chemists or physicists or with clinicians … some problems will require combined efforts'. I believe this kind of collaborative approach could frame the design of any curriculum or teaching programme.

Analogous to a powerful microscope lens, I have found that LCT makes visible the invisible organising principles of practices, contexts and dispositions while rigorous explanatory power allowed my objectivity to operate as an inside researcher. With a sharp focus on knowledge and curriculum concurrently socio-epistemic I believe I have contributed theoretically in showing the explanatory power of LCT to make sense of knowledge structures and to avoid knowledge blindness. I understand that I have added to the corpus of knowledge about curriculum, professional knowledge, interdisciplinarity, the basic sciences, and rehabilitative health professions. Much of my enthusiasm for LCT derives from the realisation that any practices can be analysed, and any magnitude of element can be evaluated in its fractal analysis. This study moved along the range from abstract conceptualisation of clinical, disciplinary and laboratory practices and contexts to the condensation of meaning within a single term such as 'function' or 'structure'.

Also the findings make a contribution to research on medical education as the field is a rapidly changing one (Jones et al 2001, Drake et al 2009). While this study didn't look at case based or problem based learning, the curriculum I researched resulted after dissolution of the traditional MBChB curriculum and the implementation of PBL at the end of 2001 academic year. It was reported that underpinning curriculum renewal processes at all South African medical schools was the agreement that the new curriculum would employ an 'integrated systems-based approach' to the study of sciences basic to medicine using clinical scenarios and patients as the focus of learning, and acknowledging that the basic and clinical sciences needed to be 'integrated in order to train students to act scientifically when they practise medicine' (Seggie 2010, p12). The physiology-anatomy merger contributed to the implementation of PBL curriculum at the research site. Just as my analyses revealed gaps in knowledge resulting from an imperfectly modularised and highly segmental curriculum, so have several studies reported on gaps in knowledge in PBL curricula (Muller 2009, Glew 2003, Higgins and

Tuft-Oppitz 2009). Where the disciplinary knowledge to be learned and conceptual coherence is lost then learning can be put at risk (Muller 2009). My study raises similar issues and those involved in curriculum development in various fields of medical education need to take these into account to enable cumulative learning and enable epistemological access.

8.3 Limitations

The Human Biology curriculum has been in existence for more than a decade, yet has never been critically reviewed using LCT dimensions, so while the study was conducted at a single research site the purpose was to interrogate curricular practices and contexts with a view to student enablement, improved access to professional knowledge, and more effective teaching and learning programmes.

Whilst this research constitutes one case study, documentary analysis was comprehensive and represents a socio-educationally important twenty year period in the development of teaching programmes in anatomy and physiology, and in occupational therapy and physiotherapy. Disciplinary interview participants were few on account of the paucity of teaching staff on the foundational programme. I have also disclosed that I taught on the programme. The low number of disciplinary candidates was in my view mitigated by the richness of the data. The two representatives for the professional programmes were experienced, knowledgeable senior practitioners who were matched for their professional rank and involvement in clinical programming. It is my understanding that the richness of the data and full disclosure, in order to work towards more effective learning and best fundamental curriculum practices for trainee practitioners, moderated the possible limitations.

Thanks to astute guidance from my promoter/ supervisor on writing nuanced narrative, and on the essential detachment needed for sociological reportage especially with close-up research, and thanks to the rigorous theorising provided by LCT, I feel confident of an objective stance throughout the thesis.

8.4 Recommendations for future research

My research was premised on wanting to know how to go about establishing more effective teaching and learning programmes which would enable full participation and

access, and which could potentiate students' success and in this regard I understand that experiences of being an insider benefitted my research. I understand there could be a similar study I could undertake which would apply to non-professional programmes, for example the BSc registered in the Science Faculty where physiology is recognised as a major subject, yet the course offered has become generalised human biology. I would like to extend investigations of cumulative learning by applying semantic gravity and semantic density to the evaluative and pedagogic arena by respectively analysing students' assessments, and utilising classroom observations. This would provide the student voice I was unable to bring into this study for ethical reasons cited in Chapter 5.

This study I feel could be taken further using the Autonomy dimension of LCT to explore matters like disciplinary cultures, identities and autonomy of knowledge-knowers that exist or persist after organisational restructuring and mergers.

Similar studies could be applied to any situations of interdisciplinary mergers, curriculum restructuring, professional programmes or where the democratic ideals of cumulative learning and access to powerful knowledge need to be better understood.

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APPENDICES

1.1. PHYSIOTHERAPY- SPECIFIC COURSES

MOVEMENT SCIENCE (1-3)

Movement science includes biomechanics of the human body, kinetic handling and the basic concepts involving physiotherapy. The treatment techniques of movement, orthopaedic manual therapy, massage and electrotherapy, neural development therapy are taught intensively.

MOVEMENT SCIENCE 1

(2004)Exercise therapy: basic concepts of science of movement and their application to physiotherapy practice. Analysis of normal movement as well as assessment tx related to movement dysfunction.
(2004)Movement Science: electrotherapy: electrophysical modalities in tx. Requires students to have understanding of relevant physical principles, indications and contraindications; basic neuro-muscular techniques.

(2006): This course includes basic concepts of science of movement and their application to PT practice. Course includes development and analysis of normal movement as well as assessment and treatment techniques related to movement dysfunction. This course is taught through lectures, prac sessions + tuts. Therapeutic massage includes learning of basic neuromuscular techniques and specialized massage techniques that are employed by PT. In 2nd sem students will be exposed to clinical situation in order to familiarise with scope of PT practise. Course is taught through lectures, prac sessions, tuts and clinical exposure.

(2009) **MOVEMENT SCIENCE 1 (half course)**
Students are introduced to the basic terminology and science associated with hu movement. Course content incl basic assessment and mobilisation of joints, principles of muscle strengthening and theories of soft tissue healing. Course is taught through lectures, prac demonstrations, workshops, self-study sessions and tuts. Courrse is prerequisite for AHS101034s intro to applied PT.
Key outcomes - students able to:

- Apply Techniques of joint mobilisation
- Measure range of motion
- Evaluate muscle strength, apply principles of strengthening
- Understand soft tissue healing, tx soft tissue dysfunction

(2009) INTRODUCTION TO APPLIED PHYSIOTHERAPY (half course)
This course builds on the foundational concepts; terminology and science covered in Movement Science 1.
Course content includes therapeutic massage, exercise prescription, posture analysis, correction of postural dysfunction and normal development. Students are exposed to clinical situation in order to familiarise them with the scope of PT practice, students accompany senior PT student on duty at GSH on weekly basis. Debriefing sessions every alternate week to discuss students experiences in clinical areas.
Key outcomes – students are able to:

- Apply therapeutic massage + tissue mobilisation
- Describe normal infant develop problems of movement dysfunction
- Assess posture and postural re-education.
- Prescribe, demo, teach exercises to address

MOVEMENT SCIENCE 2 covers orthopaedics, neuromusculoskeletal conditions and women's health(removed '06)

Orthopaedics – covers the scope of traumatic orthopaedics in terms of understanding pathology, presentation and basic principles of orthopaedic management as well as the appropriate PT interventions. Focus is on the *assessment (intro 2007 -) and treatment of simple fractures of the limbs and spinal column.
Neuromusculoskeletal - intro into assessment, treatment of peripheral neuromusculoskeletal conditions. Focus is on PT management of conditions commonly seen in community-based outpatients' clinics.
Women's health - this includes PT practice as it relates to pregnancy and birth process, conditions associated with menopause and mastectomy. *Womens' Health removed in 2006

MOVEMENT SCIENCE 3 - covers the fields of orthopaedics and neuromusculoskeletal conditions

Orthopaedics- Focuses more on cold orthopaedics (*including congenital and acquired pathologies* *until 2013 then *specifically rheumatological conditions*), joint replacements and non-traumatic spinal conditions. *(from 2006) *Peripheral nerve injuries, amputations and hand injuries are included.* Orthopaedic management and PT interventions.
Neuromusculoskeletal: progression of previously learnt techniques to include vertebral mobilisation as it relates to normal movement, function and stability. The course is designed to equip students with an integrated approach to working with neuromusculoskeletal disorders in the clinical setting. (*from 2011) …focusses on assessment and management of NMS disorders emphasising clinical reasoning skills and use of evidence based practice within holistic approach

INTRO.APPLIED PHYSIOTHERAY (half course emerges from Movement Science 1 in 2009) - Builds on the foundational concepts; terminology and science covered in Movement Sc 1. Course content includes therapeutic massage, exercise prescription, posture analysis, correction of postural dysfunction and normal development.

Students are exposed to clinical situation in order to familiarise them with the scope of PT practice, students accompany senior PT student on duty at GSH on weekly basis. Debriefing sessions alternate week to discuss students' experiences in clinical areas. Outcomes:

- Apply therapeutic massage + tissue mobilisation
- Describe normal infant develop problems of movement dysfunction
- Assess posture and postural re-education.
- Prescribe, demo, teach exercises

APPLIED PHYSIOTHERAPY 1a covers paediatric neurology & neurocardiorespiratory (prev cardiopulmonary) rehabilitation.

Paediatric neurology: covers theory of child development as well as assessment and tx techniques used by PTs in this field. There is a strong emphasis on epidemiology of paediatric neurology in SA and on issues surrounding child development in this country.
Cardio-Pulmonary rehabilitation: (until 2004) This component covers theory & practical application of cardiopulmonary rehab.
Neuro-Cardio-Respiratory rehabilitation (from 2005). This component covers the theory, manual and technological techniques of assessment and treatment of neurocardiorespiratory conditions. Emphasis is on primary health care and problem solving.
* (2006) *Nursing elective: students are required to do nursing elective (40 hours) at any facility recognised by Divisional Board of PT.*
* (2007) *Nursing elective removed and Electrotherapy added*
Electrotherapy: Theoretical + practical components of electrotherapy. Includes application of electrophysical modalities in PT management of pts. Requires students to have understanding of relevant physical principles, indications and contraindications applicable to each modality + ability to apply modalities safely.

APPLIED PT 1b → CLINICAL PHYSIOTHERAPY (2005) - theory and practical application of respiratory, orthopaedic, neurological, surgical & medical conditions. Students spend time in various clinical areas working with patients under supervision. Clinical reasoning sessions are included.

(2007) Nursing elective (40 hours) is added. The course is assessed entirely through continuous assessment in the clinical arena. Student's performance in each clinical block is assessed at end of rotation. Students require average of 50% or above to complete crse satisfactorily.
(2011) The course incorporates Disability in Primary Health Care, a multidisciplinary module offered by Primary Health care Directorate.

APPLIED PHYSIOTHERAPY 2a - adult neurology and cardiopulmonary rehabilitation and burn rehabilitation.

Adult neurology – aims to equip student with key knowledge and skills pertaining to PT management of variety of adult neuro conditions. Course contains applied neurosciences modules as well specific neuro conditions. Modules are designed to develop clinical reasoning and creative problem solving skills within the SA context. *emphasis is on primary healthcare and clinical reasoning (2006).
NeuroCardioRespiratory (prev cardiopulmonary) rehab and burn rehabilitation: this component covers theory and practical application of cardiopulmonary rehabilitation and the management of burns.
(2005) this component aims to equip student with knowledge and skills to assess situation, take into consideration the whole person and environment, critically analyse a situation, interpret the information, critical appraisal, implement programs, apply knowledge from relevant scientific fields etc.
(2011) Cardiopulmonary rehabilitation: (reverts to previous terminology of '04) - aims to equip student w the knowledge and skills pertaining to PT management of variety cardiopulmonary conditions which include cardiothoracic surgery and common pulmonary conditions. Emphasis is on primary health care and clinical reasoning.
(2009) General rehabilitation: This component addresses the management of conditions which require long-term, holistic rehabilitation such as burns and geriatrics. … covers techniques of management such as proprioceptive neuromuscular facilitation and splinting.

APPLIED PHYSIOTHERAPY 2b - theory & practical application of respiratory, orthopaedic, neurological, surgical and medical conditions. Students spend a portion of the week in various clinical areas working with patients under supervision. Incl clinical reasoning sessions.
*(2008) students have clinical exam at end of each rotation. This takes form of patient treatment. Performance is assessed by clinical staff
*(2010) The final course mark is composed of five rotation marks. Each rotation mark is comprised of clinical examination (60%) and performance evaluation (40%)
*(2011) This course provides practical exposure to areas of cardiopulmonary, orthopaedic, musculoskeletal, and geriatric care. As well as community settings, students spend 4 mornings a week in various clinical settings, working under supervision, with patients.

APPLIED PHYSIOTHERAPY 3a - theory & practical application of respiratory, orthopaedic, neurological, surgical, medical conditions. Students spend time in various clinical areas working with patients under supervision and participate in clinical reasoning sessions.

(2006) Course consists of variety of workshops/teaching sessions on specialist advanced topics within physiotherapy and SA healthcare. Also comprises modules on sports physiotherapy and on pharmacology. The course is taught by lectures, practical sessions, tutorials.

CLINICAL PHYSIOTHERAPY 3 (emerged from Applied PT 3 in 2005) Theory and practical application of respiratory, orthopaedic, neurological, surgical, medical conditions. Students work in various clinical areas with patients under supervision.

(2013) This course addresses the practical application of cardiopulmonary, orthopaedic, neurological, musculoskeletal and other tertiary level skills. Students spend approximately 30hrs per week in clinical areas working under supervision with patients. In addition there is a 3 week elective period where students may work at any health care facility recognised by the divisional board. The course is taught entirely through clinical practice and group teaching.

1.2. OCCUPATIONAL THERAPY-SPECIFIC COURSES

Occupational Therapy 1 (OT1)

(2001) The foundation course introduces the modules of human occupation and development. Technology (personal & interpersonal) and professional practice. These modules are taught in each year of programme.
(2004) Introduction to OT: Study of human occupation and development. Relationship between what people do and their health.
(2009) OT1: Human occupation & development; Occupational perspectives on health and wellbeing.

Occupational Therapy 2 (OT2)

Kinesiology, ergonomics, assessment of physical & psychosocial function and dysfunction.

(2001) Human occupation, biomechanics, kinesiology, ergonomics, and assessment techniques (physical & psychosocial function and dysfunction, and occupational performance. The emphasis of all modules in this year of study is on function.

(2004) Biomechanics, ergonomics, and kinesiology support the development of clinical competencies. Human functioning in self-care, productivity and participation in life tasks... OT processes & assessment techniques for identifying health and occupation needs.

(2005-) Community education projects enable students to integrate OT perspectives with primary healthcare philosophy.

Occupational Therapy 3 (OT3)

Treatment techniques, sensory, motor, perceptual dysfunction.

(2001) Focus of study is the application of theory and the development of practice skills. Treatment principles applied to problems, setting, conditions. Fieldwork. Taught methods of clinical reasoning personal reflection. 3 fieldwork placements.

(2004 onwards)

- Assessing effect & optimising physical and psychosocial environment.
- Theory of OT clinical reasoning including understanding illness & disability experiences or health, development and occupational needs from client perspective. Comprehensive healthcare principles applied to functional problems resulting from impairment, health conditions, and developmental disorders.

Occupational Therapy 4 (OT4)

Understanding strengthened by student centred approach. treatment techniques, sensory,motor, perceptual dysfunction
Foundations and Method 2
Theory and practice 2
Practice/ service learning 2

(2011-)
OT Research and practice management
Foundational theory for OT practice
OT practice & service learning

2.1. BSc PHYSIOTHERAPY: 4 year curriculum (1994-2003)

<table>
<tr><th>1994 ✓</th><th>1999 ✓</th><th>2001 ✓</th><th>2003✓</th></tr>
<tr><td><u>1st year</u>

Anatomy & Cell Bio (OT/PT/MBChB) (half) - cell biology, histology, embryology, anatomy of body systems. Foundation for regional micro- macroscopic anatomy 2nd yr.

Human Biology (MBI100W)
study of humanity: evolution, cultural ecology, health & disease, medical & social anthropology. *became Health & Soc in '95

Physics (half course)
<u>Movement Science</u> (1a+b; 2a+b)</td><td><u>1st year</u> (Anatomy half course out; Biomechanics in)

Health and Society
Intro to Health Sciences
Physics (half course)
Biomechanics (half course)

<u>Movement Science</u> 1a-d</td><td><u>1st year</u> (Physics out, Xhosa in)

Health and Society
Intro to Health Sciences
Xhosa for PT (half)
Biomechanics

<u>Movement Science</u> 1a-d</td><td><u>1st year</u> (Anat & Physiology HUB105 in; Biomechanics out, BP + BHP in)

Anatomy & Physiology for HRS
Intro to Health Sciences
Xhosa for PT

Becoming a professional (half)
Becoming health professional

<u>Movement Science</u> 1a-d</td></tr>
<tr><td><u>2nd year</u>

Anatomy for PT (ANT208W)
Physiology PT/MBChB (PGY 202W)

<u>Movement Science</u>: 3a- 3b

<u>Applied Physiotherapy</u> 1a-b
Theory and practical treatment of respiratory, orthopaedic, neurologic, surgical, medical conditions. Students work with patients in various clinical areas.</td><td><u>2nd year</u>

Anatomy for PT
Physiology (PGY 202)

<u>Movement Science</u>: 2a- 2b

<u>Applied Physiotherapy</u> 1a-b</td><td><u>2nd year</u> (Anatomy for PT, Physiol for PT semesterised)

Anatomy for PT II
(HUB202W)
Physiology: maintenance of homeostasis (HUB 214f)
Physiology: organ systems
HUB213s

<u>Movement Science</u>

<u>Applied Physiotherapy</u></td><td><u>2nd year</u> (Anat for PT out; Biomechanics in)

Biomechanics (half)
Physiology: homeostasis
Physiology: organ systems

<u>Movement Science</u>

<u>Applied Physiotherapy</u></td></tr>
<tr><td><u>3rd year</u>

<u>Movement Science</u> 4a+b

<u>Applied Physiotherapy</u> 2a-2b

Health Science: human behaviour
Health Science: community medicine
Clinical sciences</td><td colspan="2" rowspan="2"><u>3rd – 4th year</u>

→ Curriculum stable / unchanged since 1994 →</td><td><u>3rd year</u> (Res methods & stats in)

<u>Movement Science</u>: 3a+b

<u>Applied Physiotherapy</u>: 2a-2b

Health Science: hu behaviour
Health Science: comm. medicine
Clinical sciences
Research methods & biostatistics (half course)</td></tr>
<tr><td><u>4th year</u>

<u>Applied Physiotherapy</u> 3a -3b

Practice management (PTH405)
Research project (PTH404)</td><td><u>4th year</u> (Res methods & stats in)

<u>Applied Physiotherapy</u>

Practice management
Research project
Research methods & biostatistics (half course)</td></tr>
</table>

2.1. BSc PHYSIOTHERAPY: 4 year curriculum (2005 - 2013)

<table>
<tr><th>2005✓</th><th>2006✓</th><th>2009✓</th><th>2011-13✓</th></tr>
<tr><td><u>1st year</u> (Biomechanics in, Xhosa out, Movement Sc - 2 modules)

Anatomy & Physiology 1 HRS (HUB105W)
Biomechanics (full course)

Becoming a professional
Becoming a health professional

<u>Movement Science</u>: Exercise therapy
<u>Movement Science</u>: Electrotherapy</td><td><u>1st year</u>

Anatomy & Physiology1 HRS

Biomechanics & Chemistry
(includes electrotherapy)
Becoming a professional
Becoming health professional

<u>Movement Sc. 1</u> (full course)</td><td><u>1st year</u> (HUB semesterised; Movement Sc half course; Applied PT in; Biomechanics and Chemistry separated; Psychology in)
Anat & Physiology 1A (HUB1019F)
Anat & Physiology 1B (HUB1020s)
Biomechanics for PT (half)
Chemistry for PT (half)
Becoming a professional
Becoming a health professional
Psychology 1
<u>Movement Science 1</u> (half)
<u>Intro to Applied PT</u> (half)</td><td><u>1st yr</u> (Chemistry out; biomech becomes Biosciences 1A,1B)

Anatomy & Physiology 1A
Anatomy & Physiology1B
Biosciences 1A & 1B

Becoming a professional
Becoming a health professional
Psychology 1 (half)
<u>Movement Science 1</u> (1/2)
<u>Intro to Applied PT</u> (half)</td></tr>
<tr><td><u>2nd yr</u> (Movement Sc half course; Applied PT half crse; clinical PT introduced; psychology in)
Anatomy & Physiology2 for HRS HUB215W

<u>Movement Science 2</u> (half course)
<u>Applied Physiotherapy 1</u> (half)
<u>Clinical Physiotherapy</u> 1 (half)
Psychology</td><td><u>2nd year</u> (Xhosa, Afrikaans in)

Anatomy & Physiology 2 - HRS

<u>Movement Science 2</u> (half)
<u>Applied Physiotherapy 1</u> (half)
<u>Clinical Physiotherapy 1</u> (half)
Psychology
Afrikaans
Xhosa</td><td><u>2nd year</u> (psychology moved to 1st year; Xhosa dropped)

Anatomy & Physiology 2 for HRS

<u>Movement Science 2</u>
<u>Applied PT 1</u>
<u>Clinical PT 1</u>

Afrikaans</td><td><u>2nd year</u> (Biosciences 2 in; clinical sciences in; Xhosa in)

Anatomy/Physiology2 HRS
Biosciences 2 (HUB2023W)
<u>Movement Science 2</u>
<u>Applied PT 1</u>
<u>Clinical PT 1</u>
Clinical sciences 1 (full)
Afrikaans
Xhosa</td></tr>
<tr><td><u>3rd yr</u> (Movement Sc. & Applied PT half courses; Clinical PT introduced; Health Sc- comm medicine out; BRP in)

<u>Movement Science 3</u> (half course)
<u>Applied Physiotherapy 2</u> (half course)
<u>Clinical Physiotherapy</u> 2 (half course)
Health Sciences: human behaviour
Becoming a rehab professional 1
Clinical sciences
Research methods & biostatistics 1</td><td colspan="2"><u>3rd year</u>

→ curriculum as previous →

*Special Study Module (4 wks) added in 2006
*Special Study Module (4 wks) removed 2009</td><td><u>3rd year</u> (clinical science 1 in 2nd yr; Clinical Science 2 in 3rd yr)

curriculum as previous

Clinical sciences 2</td></tr>
<tr><td><u>4th year</u> (Clinical PT in; Applied PT half course; BRP 2)

<u>Applied Physiotherapy 3</u> (half course)
<u>Clinical Physiotherapy 3</u> (full course)

Becoming a rehab professional 2

Research methods & biostatistics 2
Research project</td><td><u>4th year</u> (Research project dropped!)

<u>Applied Physiotherapy 3</u>
<u>Clinical Physiotherapy 3</u>

Becoming rehab professional 2

Research methods & biostatistics2
Research project falls away 2006</td><td colspan="2"><u>4th year</u>

→ curriculum as previous</td></tr>
</table>

2.2. BSc OCCUPATIONAL THERAPY: 4 year curriculum (1995-2001)

1994 ✓	1995 ✓	1999 ✓	2001 ✓
1st year	***1st year:*** *(physics in)*	***1st year:*** *(Anat dropped for bus managment)*	***1st year:*** *(physics dropped; OT 1 develops)*
Anatomy & Cell Bio (OT/PT/MBChB) Cell biology, histology, embryology, anatomy of body systems. Foundation for regional micro- macroscopic anatomy 2nd yr. *Human Biology (MBI100W)* Study of humanity: evolution, cultural ecology, health & disease, medical & social anthropology. *became Health & Soc in '95 Psychology 1 Occupational Therapy 1	Anatomy & Cell Bio (half) **Physics** (half) **Health & Society** Psychology 1 Occupational Therapy 1	**Introduction to management** Physics Health & Society Psychology 1 Occupational Therapy 1 Theory of practice with professional focus on human occupation, human development through the lifespan	Intro to management Health & Society Psychology 1 **Occupational Therapy 1** Foundation course introduces modules of human occupation & development, technology (personal & interpersonal) and professional practice. These modules are taught in each year of programme.
2nd year	***2nd year – 4th year:***	***2nd year*** *(changes in OT 2)*	***2nd year*** *(changes in OT 2)*
Anatomy for OT (ANT207W) Physiology for OT / nurses (PGY 203W) Psychology 2 Occupational Therapy 2	***unchanged from previous***	Anatomy for OT Physiology for OT Psychology: research psychology Psychology: learning, language, cognition **Occupational Therapy 2** Kinesiology, ergonomics, assessment of physical & psychosocial function/dysfunction.	Anatomy for OT Physiology (OT/Dietetics/Pharm) Psychology: research Psychology: personality/ development **Occupational Therapy 2** Hu occupation, biomechanics, kinesiology, ergonomics, and assessment techniques (physical & psychosocial function-dysfunction and occupational performance). Emphasis of all modules is on function.
3rd year		***3rd year – 4th year:***	***3rd year*** *(changes in OT 3)*
Psychiatry Clinical science: aetiology, clinical signs -symptoms (some microbiology) Occupational Therapy 3 Treatment techniques, sensory, motor, perceptual dysfunction.		***unchanged from previous***	Psychiatry Clinical science **Occupational Therapy 3** Focus of study is application of theory and development of practice skills. Treatment principles applied to problems, setting, conditions. Fieldwork. Taught methods of clinical reasoning and personal reflection. 3 fieldwork placements.
4th year			***4th yr***
Occupational Therapy 4 Understanding strengthened by student-centred approach. Treatment techniques, sensory, motor, perceptual dysfunction			Occupational Therapy 4

2.2. BSc OCCUPATIONAL THERAPY: 4 year curriculum (2003-2013)

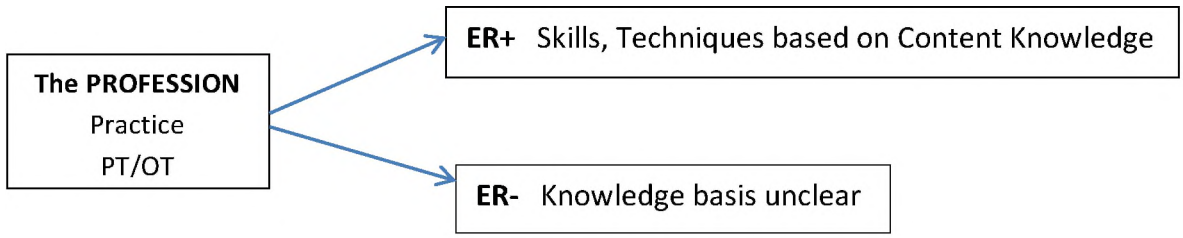
2003 ✓	2005 ✓	2009✓	2011-2013 ✓
1st year: *(Anat & physiology for HRS1; Xhosa in, BP and BHP in)* **Anatomy & Physiology for HRS** (HUB105W) **Becoming a professional** **Becoming health professional** **Xhosa** Psychology 1 Introduction to OT 1	***1st year*** Anatomy & Physiology for HRS (HUB105W) Becoming a professional Becoming a health professional Xhosa **Afrikaans** Psychology 1 Introduction to OT 1	***1st year***: *(HUB semesters, Xhosa, Afrik dropped; OT 1 semesterised)* **Anatomy and Physiology 1A** HUB1019 **Anatomy and Physiology 1B** HUB1020 Becoming a professional Becoming a health professional (BHP) Psychology 1 Introduction to OT 1 Human occupation & development (half) Occupational perspective on health, wellbeing (half)	***1st year***: *(psychol semesterised)* Anatomy / Physiology 1A Anatomy / Physiology 1B Becoming a professional BHP Intro to Psychology 1 Intro to Psychology 2 Introduction to OT 1 Human occupation & development Occupational perspective on health, wellbeing
2nd year Anatomy for OT II HUB201W Physiology (OT) HUB 210W Psychology: personality / development Psychology: social psych. /group relations Introduction to OT 2	***2nd year*** *(Anat & Physiol for HRS)* **Anatomy & Physiology 2 for HRS (HUB215W)** Psychology: development psych. Psychology: social psych./group relations **Introduction to management** Introduction to OT 2	***2nd year*** Anatomy & Physiology 2 for HRS (HUB215W) Psychology:development psych Psychology: social /group relations Intro to management Introduction to OT 2	***2nd year:*** *(business dropped, clin sci & psychiatry added)* Anatomy & Physiology 2 - HRS Psychology: development Psychology: social/grp relatns **Psychiatry** for OT **Clinical Sciences** 1 Introduction to OT 2
3rd year Clinical science Psychiatry Occupational Therapy 3 OT foundations and methods OT theory & practice OT fieldwork	***3rd year*** *(Res methods & stats in)* Clinical science Psychiatry OT **Research methods & biostats** Occupational Therapy 3 OT foundations and methods OT Theory & practice OT **service learning**	***3rd year*** Clinical science Psychiatry OT Research methods & biostats Occupational Therapy 3 OT foundations and methods OT Theory & practice OT **practice learning**	***3rd yr*** *(psychiatry out, clin sci out; xhosa & afrik in; changes OT 3* **Xhosa** for HRS **Afrikaans** for HRS Res methods & biostats Occupational Therapy 3 Foundations of OT practice Theory & practice in **physical health** Theory & practice in **mental health**
4th year Occupational Therapy 4 OT foundations and methods 2 OT theory & practice 2 OT fieldwork 2	***4th year*** Occupational Therapy 4 OT foundations and methods 2 OT Theory & practice 2 OT **service learning** 2	***4th year*** Occupational Therapy 4 Foundation & methods 2 Theory & practice 2 ***Practice*** learning 2	***4th year*** OT4 -2012) Foundation & methods 2 Theory & practice 2 Practice learning 2 OT4 2013- Research & practice management Foundational theory for OT practice OT practice & service learning

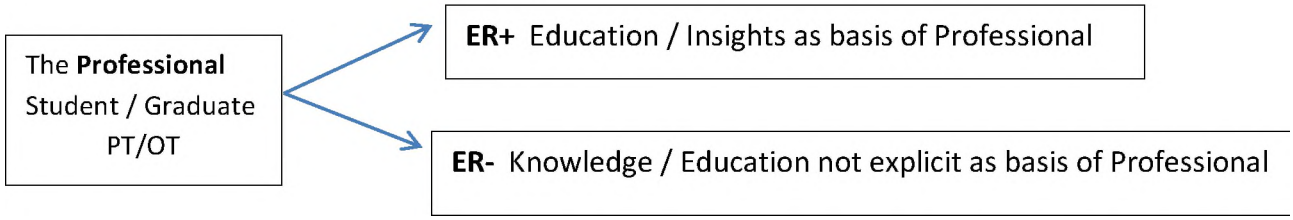
3.1. A Guide to coding: developing explanatory power using Specialisation

To explain how the theoretical concepts (internal language) are instantiated in the data I used Chen's guidelines for developing an 'external language'. The premise with Specialisation is:

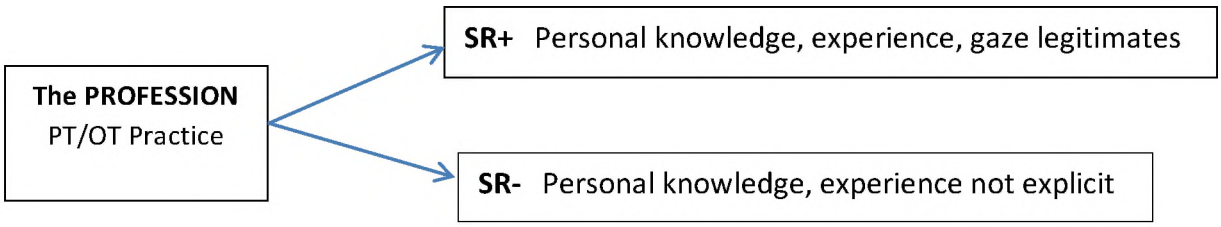
SR relates to an emphasis on attributes, experience, disposition, gaze
ER relates to an emphasis on skills, techniques, dexterity borne from content knowledge

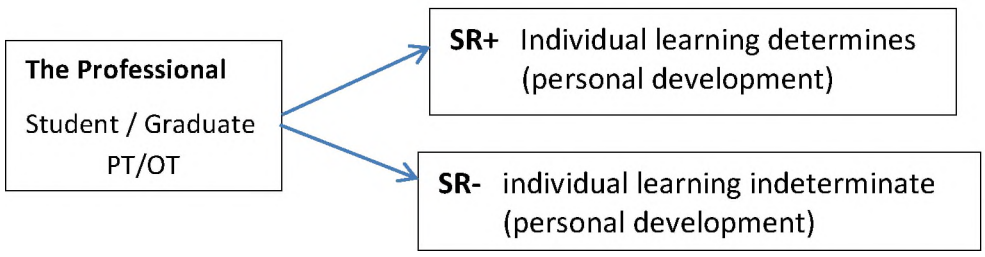
Knowledge basis



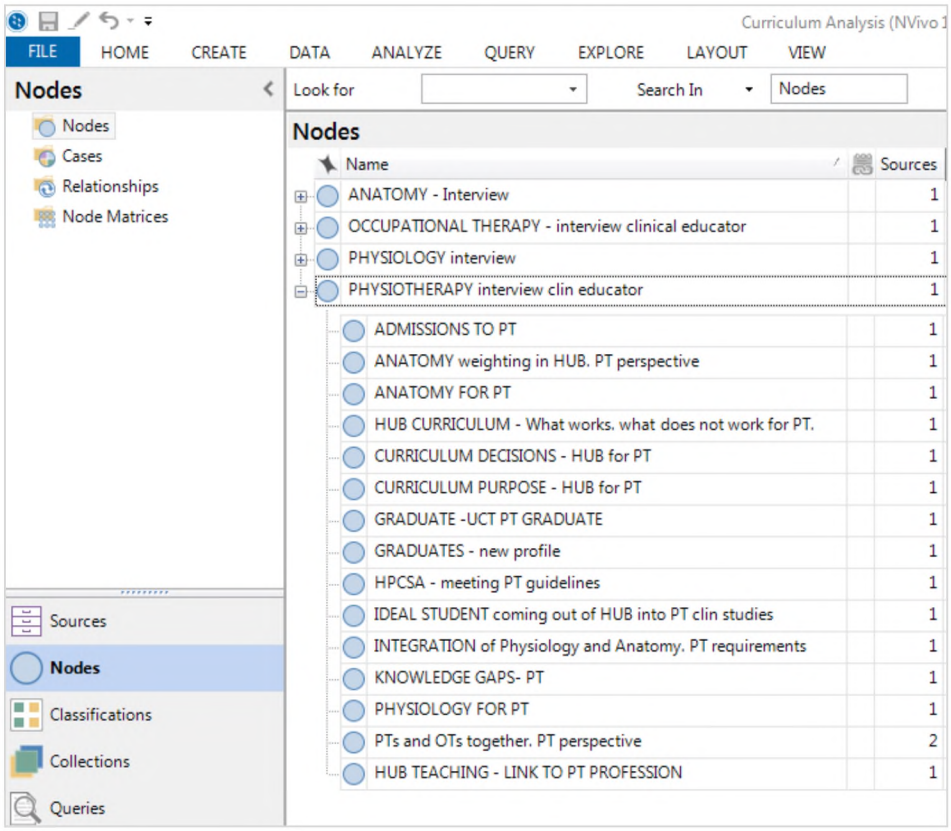


Personal Experience/gaze





3.2. Physiotherapy: NVIVO nodes generated from interview with PT clinical educator



3.3 Anatomy: data nodes generated from interview with Anatomy lecturer